WORK

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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Fig. 1.

Fig. 2.

Fig. 2*a*.

Fig. 3.

Fig. 14.

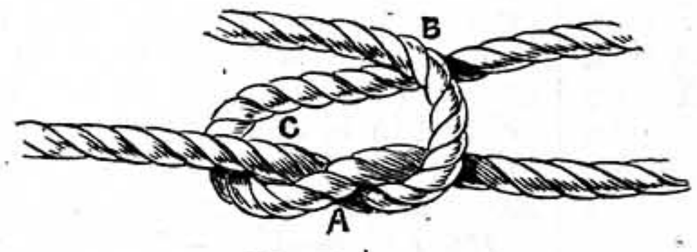


Fig. 5.

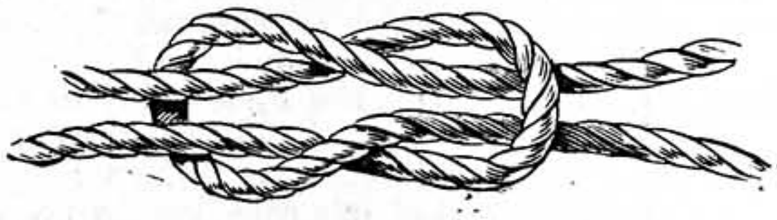


Fig. 4.

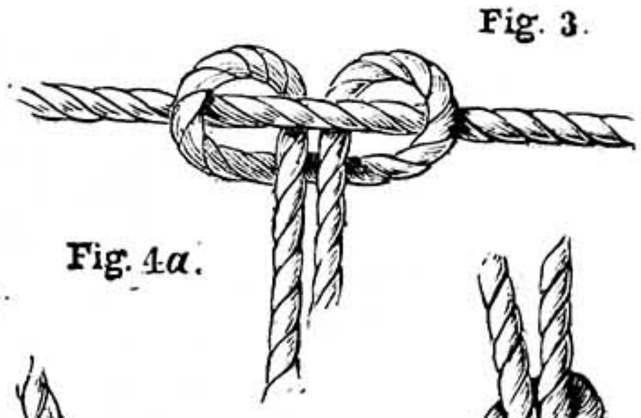


Fig. 4*a*.

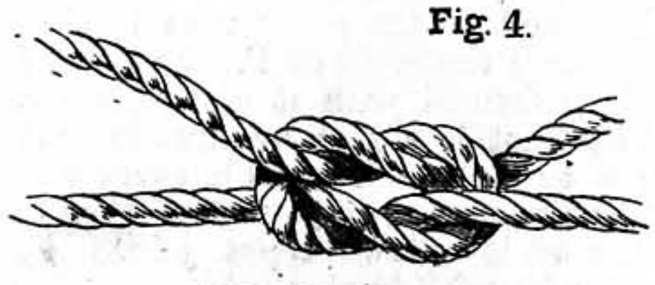


Fig. 6.

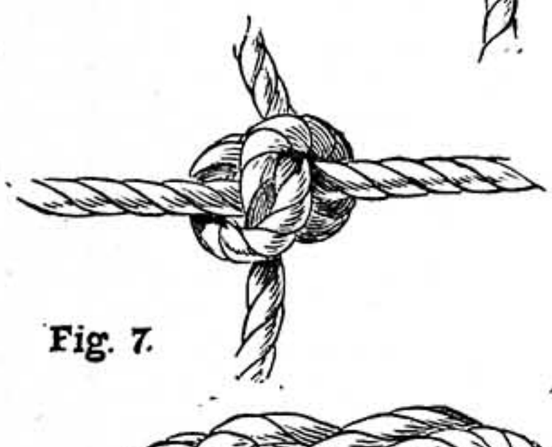


Fig. 7.

Fig. 8.

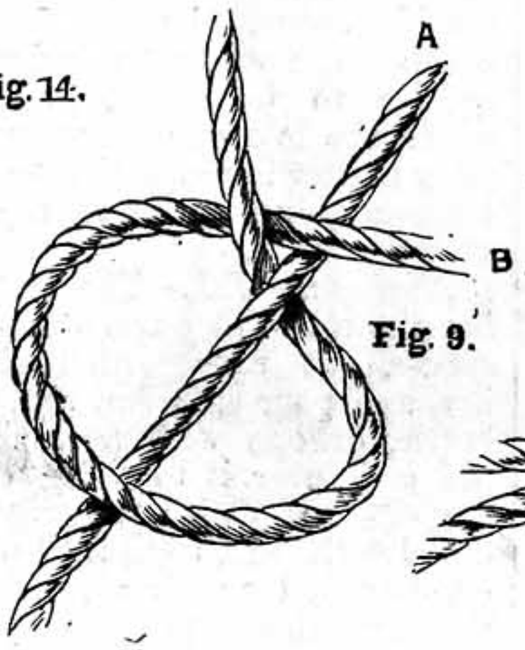


Fig. 9.

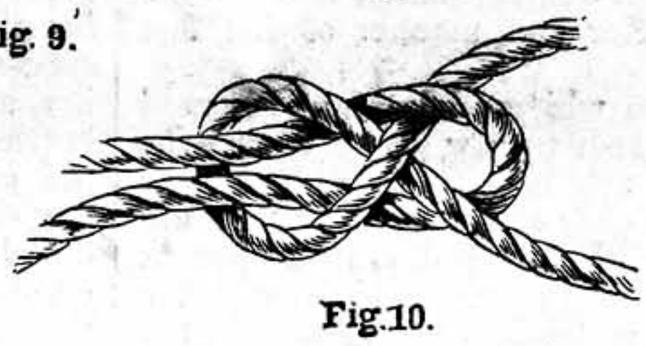


Fig. 10.

Fig. 11.

Fig. 13.

Fig. 12.

Fig. 1.—Overhand Knot. Fig. 2.—Fourfold Overhand Knot. Fig. 2*a*.—Ditto, closed. Fig. 3.—Figure-of-Eight Knot. Fig. 4.—Reef Knot. Fig. 4*a*.—Ditto, hauled straight. Fig. 5.—Ditto, half made. Fig. 6.—Granny Knot. Fig. 7.—Ditto, closed. Fig. 8.—Overhand Rosette Knot or Bow. Fig. 9.—Weaver's Knot, half made. Fig. 10.—Ditto, closed. Fig. 11.—Overhand Knot joining two Ropes. Fig. 12.—Flemish Knot joining two Ropes. Fig. 13.—Whipcord Knot. Fig. 14.—Fisherman's Knot.

KNOTTING, SPLICING, AND WORKING CORDAGE.

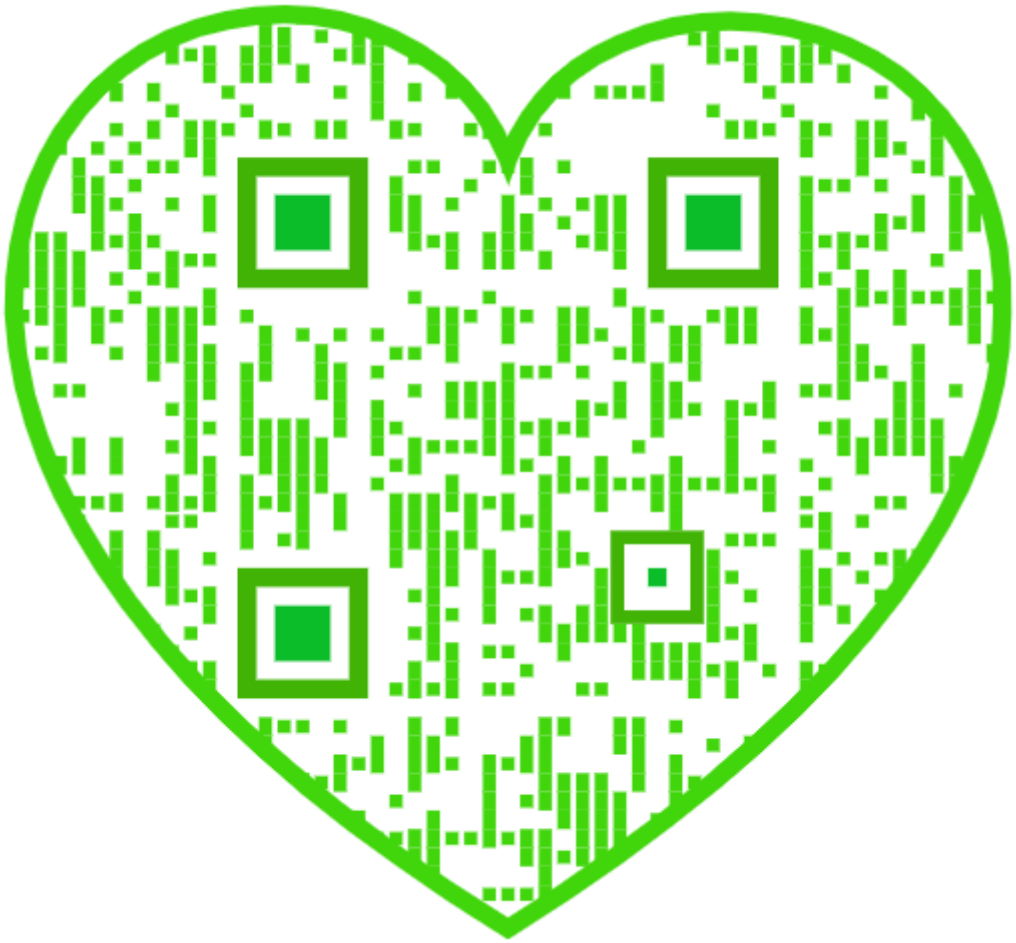
BY LANCELOT L. HASLOPE.

SIMPLE KNOTS AND KNOTS FOR UNITING ROPES.

OVERHAND KNOT—FOURFOLD KNOT—FIGURE-OF-EIGHT KNOT—REEF KNOT—GRANNY KNOT—ROSETTE KNOT OR BOW—OPENHAND KNOT—WEAVER'S KNOT—OVERHAND KNOT JOINING TWO ROPES—FLEMISH KNOT JOINING TWO ROPES—WHIPCORD KNOT—FISHERMAN'S KNOT.

Simple Knots.—Overhand knot (Fig. 1). This is the simplest knot that is made; at the same time it is a very useful one. It also forms a part of many other knots. To make it, the standing part of the rope—that is, the main part in opposition to the end—is held in the left hand, and the end of the rope is passed back over it (whence its name) and put through the loop thus formed. It is often used at the end of a rope to prevent the strands unlaying. It is also sometimes used in the middle of a rope as a stopper knot. If we pass the end of the rope through the bight two, three, or more times before hauling it taut, we then have the double, treble, or fourfold knot (Fig. 2). This forms a larger knot than Fig. 1. It is often used on the thongs of whips, and is then termed a blood knot. Fig. 2*a* shows the knot hauled taut. Fig. 1 also goes by the name of the Staffordshire knot, as it forms the insignia of the county. A Flemish or figure-of-eight knot is shown in Fig. 3. To make it, pass the end of the rope back, over, and round the standing part, and up through the first bight. For the benefit of my non-nautical readers, I may say here that the bight of a rope is the loop formed when a rope is bent back on itself, in contradistinction to the ends. The term is also used for the bend in the shore forming a bay—as the Bight of Benin. The Flemish knot is used for much the same purposes as the preceding knots, but is rather more ornamental.

Knots for Uniting Ropes.—The circumstances under which we have to join the ends of two pieces of cordage together are very various, and several methods of doing so are brought into requisition at different times, but it is always of considerable importance that the most suitable knot be employed in each case. The value of some knots consists in the rapidity with which they can be made, and in the case of others in the readiness with which they can be undone, but it is a *sine quâ non* that the knot should hold firmly and not slip when once hauled taut. The commonest knot for joining the ends of two ropes, and probably the knot that is most often made, is the sailor's, true, or reef knot (Figs. 4 and 5). When correctly made it is as perfect as a knot can be. It can be made very rapidly and undone with equal ease, and is very secure when taut. It has, however, one disadvantage—it will not answer when made with ropes of different sizes, as it then slips and comes adrift, but where the



two pieces of cordage are of the same size it is a most secure and reliable knot, the strain on every part being so equally distributed. Though very readily made when once you get in the way of it, it requires a little practice to make it properly. To do this, take an end in each hand and lay one over the other, the right end being undermost; bring the left-hand end under the standing part of the right end, as shown at A, Fig. 5, and over the end at B, round it, and up through the bight at C. The key to the knot I take to be putting the right end under the left when the two ends are crossed at the commencement of the knot, as the left-hand end then comes naturally first over and then round the other rope, and the ends lie parallel with the standing parts, as in Fig. 4. If the ends are not passed correctly, a granny, lubber's, or calf knot results. This is shown in Fig. 6. Though at first sight this seems to be a good knot, yet it is not so in reality, and when any strain comes upon it it slips and becomes useless. Fig. 7 is a granny knot, as it appears when hauled upon. It is considered a very lubberly thing to make a granny knot, and my readers should practise until they can make a true knot rapidly and with certainty in any position. The sailor's knot is invariably used for reefing sails, the ease with which it can be undone making it very valuable for this purpose. You have only to take hold of the two parts on each side just outside the knot and bring the hands together, and the loops slip over one another, as in Fig. 4, and the knot can be opened at once. This knot has a curious peculiarity which I do not think is generally known. If we take hold of the end of one of the ropes in one hand and the standing part of the same rope in the other, and haul upon them until the rope is straight, the knot becomes dislocated, so to speak, and the rope not hauled upon forms a hitch (Fig. 4*a*) round the other part. This property was the secret of Hermann's celebrated trick, "the knotted handkerchiefs." After the handkerchiefs were returned to him by the audience knotted together at the corners, under pretence of tightening the knots still more, he treated each knot as I have described. To the superficial observer the knots seemed as firm as ever, but in reality they were loosened so that a touch with his wand separated them easily. The common bow or rosette knot is a modification of the sailor's knot. The first part of the process of making it is the same, but instead of passing one end singly over and under the other, as in the sailor's knot, both ends are bent back on themselves, and the double parts worked as before. Care must be taken to pass these doubled ends exactly as those described in the sailor's knot, or a granny bow will result. One often hears people say that they cannot understand *why* their shoes are always coming untied, the reason being that they were tied with granny instead of true bows. Another way of joining the ends of two pieces of cordage is shown in Fig. 8. This is merely an overhand knot, made with two ropes instead of one. It is also sometimes called an open-hand knot. It can be made very quickly, and there is no fear of its slipping, but if there is much strain put upon it the rope is very apt to part at the knot, in consequence of the short "nip," or turn, that it makes just as it enters the knot.

Fig. 9 shows the weaver's knot partly made, and Fig. 10 the same knot completed, but not hauled taut. This knot is called by weavers the "thumb knot," as it is made over the thumb of the left hand, and is used by them in joining their "ends" as they break. No one would believe, without seeing them, the rapidity with which they make the knot, snip the ends off, and set the loom going again. It is used by netters to join their twine. It also forms the mesh of the netting itself, though, of course, it is then made in a very different way. In making the weaver's knot, we cross the two ends to be joined in the same way as in the sailor's knot, placing the right end under, and holding them with the thumb and finger of the left hand at the place where they cross. The standing part of the right-hand rope is then brought back over the thumb and between the two ends, as shown in Fig. 9. The end A is then bent down over it, and held with the left thumb, while the knot is completed by hauling on B. We shall meet with this knot again further on.

Fig. 11 shows an excellent way of joining two ropes. It can be made by laying the ends alongside one another, overlapping each other sufficiently to give room for the knot to be made. The double parts are then grasped in each hand and an overhand knot is formed, which is made taut by hauling on both parts at once, as if the knot was single. Though this is the easiest way to make the knot, it is not available where the ropes are fast. In this case we make a simple knot on the end of one rope, but do not draw it taut. The end of the other rope is then passed through the bight of the first, and a second loop formed with it alongside the first. The knot is closed by drawing the two ropes as before. This is in every way an excellent knot, and very secure. Fig. 12 shows the ends of two ropes joined by means of a Flemish knot.

This does not require much description. It is made after the manner of the last knot.

Fig. 13 is the whipcord knot, and is used to fasten the lash to a whip; A shows the thong, and B the lash. The lash is first laid across the ends of the thong, which are turned up over it. The lash is then brought completely round the thong and through the loop it makes, which secures the ends of the thong firmly. If a silk lash is used, the short end is cut off, but if whipcord, the two ends are generally twisted together for a few inches, as at B, and an overhand knot made with one end round the other, which secures them. The remaining part is left somewhat longer, and another overhand knot at the end prevents it from unravelling.

The fisherman's knot (Fig. 14) is one of the most useful knots we have. It derives its name from the fact that it is always used for joining silkworm gut for fishing purposes. In making it, the strands are first laid overlapping one another, and an overhand knot made with one end round the other strand. The strands are then turned round, and another overhand knot made with the other end round the first strand. When the knot is tightened by hauling on the standing parts, one knot jambs against the other and holds securely. The knot is improved by putting the ends twice through their respective loops, as in Fig. 2. The size of the knot is increased by this means, but it will stand a much heavier strain, so that it is advisable to do this whenever the size of the knot is not of paramount importance.

The attention of the reader is called to the illustrations of the various knots mentioned above, which show in the clearest manner possible the nature and character of each knot, and how it is made.

ARTISTIC LITHOGRAPHY.

BY A. J. ABRAHAM.

MATERIALS.

THE INK—ITS PREPARATION—MIXING THE INK—CHALKS—STUMPING CHALK—EFFECT OF HEAT ON CHALKS—CRAYON-HOLDERS—BRUSHES—HANDLE—CARE OF BRUSHES—DUSTING BRUSHES—LITHOGRAPHIC PENS—INSTRUMENTS.

The Ink.—After the student is satisfied that the stone is in a suitable condition for working upon, his next consideration is the materials used in the manipulation of the work, the most important and principal one being the fatty matter which is necessary to preserve the natural qualities of the stone, and with which the drawing must be made. This consists of a black ink, and is sold at all lithographic dealers in two forms, that of a solid stick of ink, and chalk.

Being unnecessary for the student to make his own ink, it will be sufficient for him to know that it is composed of certain fatty matters, such as soap, tallow, shellac, etc., mixed in various proportions, and a black pigment in sufficient quantity to allow the artist to see how his work is progressing, and also how the subject will appear when printed in black. Without this black pigment the drawing would be invisible on the stone, although it would print just the same.

Its Preparation.—When the ink is required for use it must be dissolved in soft water, and should be made fresh every day, for if allowed to stand from one day to another, it would get thick, and more water require to be added, in consequence of which the ink would not contain sufficient fatty matter in proportion to the water used for preserving the stone, especially in any very fine work.

Mixing the Ink.—The best way of mixing the ink is to warm a small earthenware saucer, cut some small pieces from the ink, and pour sufficient water from a drop-bottle, or one with a small hole cut in the cork, over it to make enough for the day, then rub with the fingers in order to dissolve the ink, until it be of the necessary consistency for working, which will be when the ink adheres to the side of the saucer. Should there be too much water, the ink will glide off, besides which it will not contain sufficient greasy matter as spoken of above; and if made too thick, it will not flow freely enough from the pen, or brush. It should be just thin enough not to spread when working with it on the stone, and just thick enough not to smear when dry.

When working with the brush it is best to use a saucer slightly tilted, but when the pen is used a small bottle is better. A large thimble makes an excellent substitute, and a very good inkstand can be made by taking a small square block of wood and cutting a hole in the centre, large enough in which to place the thimble. Any small bottle would do as well so that it is washed out every day, but the above is, perhaps, as good as anything.

Chalks.—These should be sharpened by cutting away from the point in the same manner as charcoal or an ordinary crayon; being of such a soft, greasy substance, it is very likely to break. The ordinary crayon-holder is rather heavy for lithographic chalks, and likely to make them snap. It is preferable to use a holder consisting of a wooden handle with a steel top enclosed by the usual ring for holding the chalk. This allows the slightest pressure required on the stone to be given entirely by the hand, instead of by any weight from the holder itself.

These chalks are made of various density and numbered, the hardest being a copal chalk, which should only be used for outlining very fine clear lines that cannot be made with a No. 1 chalk, which, being the next in order, is also used for outlining and fine tinting generally. No. 2 is a medium chalk, and No. 3 being very soft, is useful for strong shadows and large bold work.

Stumping Chalk.—This is not much used except in light even tints for large work, as by its very density it prints stronger than the ordinary numbers, besides which it works very flat and without any texture. It should be used with the stump or a piece of chamois leather.

A good way to use this is to keep a small piece of stone handy with an average grain, and rub a piece of the chalk across or down one side until it is quite black. Then with a small clean piece of the leather passed over the first finger of the right hand and held firmly, take some of the chalk from the stone, being careful only to rub it one way, and taking it off as evenly as possible; then try it on another part of the stone (always taking care to rub one way) to see the necessary strength required, to take off any superfluous chalk that may have adhered to the leather, and also to make it more even, or it will be likely to work in streaks. The stump or leather being now ready for working with, gum round the edges of the space required for the tint, and when perfectly dry rub the leather evenly over the surface, and the gum will prevent the chalk from adhering to the stone further than it is required. It sounds very easy just to rub an even tint on the stone, but the novice will find it requires practice to obtain an equal pressure of the finger on a surface of only a few square inches.

The student will also find on trial that it is impossible to make a chalk drawing on a polished stone, on account of the even surface not allowing the chalk to be scraped away, which is done in the case of a grained stone.

Effect of Heat on Chalks.—Heat has a great influence on the chalk, it being often possible to get the same effect with a No. 1 on a hot day in summer as by the use of a No. 3 on a cold day in winter. It is also advisable to have half a dozen chalks in use at the same time, as they are apt to get soft from the heat of the hand, and therefore will not work well.

Crayon-Holders.—The artist should have different coloured crayon-holders, so as to easily distinguish the number of the chalk he is using, and he need never throw away the chalk cuttings, for although they are of no use to him, still they make excellent ink for the printer, and a good foreman will be very glad of the perquisite.

Brushes.—The brushes used should be very fine red sable, and for fine line work it is much better that the artist should cut away the outside hairs from an ordinary size lithographic brush, leaving only the centre ones for working with, than to buy one the exact size required, which would not be as firm as a larger brush cut down.

Some writers use a brush with the hairs 1 in. long, but as they require very careful manipulation, it would not be advisable for the student to practise with them at first.

Brushes that will not always do for one thing come in very handy at times for a different object; thus a brush that has lost its point, and cannot be used any longer for drawing fine lines, may be very well used for filling in solid—that is, where a portion of the stone is required to be covered with ink, and brushes that are of no further use for ink are often suitable for gum work, but the student must be most careful in keeping the latter apart from those used for ink, as gum acts as a protection against the ink touching the stone, and, therefore, no work would print if drawn with the same brush as that used for gum, or if drawn on any part of the stone where gum has been used.

Handle.—A good handle for brushes can be obtained by using a common metal pocket penholder, in which the top can be taken off and reversed to protect the pen, or in this instance the brush, which should be fixed in with sealing-wax, of course not allowing any of the wax to go on the outside of the metal, as it would not then shut in the holder securely.

Care of Brushes.—Always wash the brush with a little soap and water when finished with it for the day. Some artists allow the ink to dry in the brush as a protection to the point, but it is a very dirty habit to get into, as the brush must always be washed before using, and it is much easier to do so the same day than if it were allowed to dry with the ink in it, and most people will agree that there is nothing so annoying as to find dirty tools when they are ready and anxious to start work.

Dusting Brushes.—The artist also requires a flat camel's-hair brush, about 2 in. in width, for dusting the stone with during the progress of the work, it being most necessary that the stone should be kept perfectly free from any specks of dust, or dirt, etc. This applies specially to chalk work, and is of so much importance that it will be referred to again when the work is explained.

A flat camel's-hair brush of not less than 4 in. in width is required for etching purposes, and should be kept when not in use in a well, similar to those used for copying brushes. It is better to have one that will hang against the wall, and only use sufficient water to cover the hair of the brush, or else the water, in conjunction with the acid used, will rot the metal of the brush.

Lithographic Pens.—Lithographic pens are much finer and more delicate, besides being more highly tempered, than the ordinary writing pens, and being very brittle are apt to snap unless carefully handled; in fact, an ordinary pen for fine work on stone is of no use whatever, on account of the difference in the substance of the ink, and the writing or drawing surface, but lithographic pens are so common that they can be obtained from most dealers besides those who deal exclusively in lithographic materials; they therefore need not be further described.

The artist should have several pens in use at the same time, for if one will not work well another will, so he can change about, and frequently a pen that is difficult to manage one day will work splendidly the next. New pens are better for the finer parts of the work, and worn ones for the coarser; and if the pen should get crossed nibbed, which is often the case, all the artist need do is to bend it back on the thumb-nail, when it will work as well as before—that is, presuming it has not snapped during the operation; but the student will soon judge for himself the pliability of the pens.

The artist should always use a good size penholder, and not merely a thin stick of wood, else the hand is apt to get cramped unless there is something firm for it to grasp, besides which the artist will work with much greater freedom; and this applies equally well to crayon and brush-holders.

Instruments.—Such instruments as the bow compasses, and ruling pens, are very highly tempered, and are specially made for drawing on stone; they should *not*, if possible, be used for drawing on paper, as it spoils them for stone work, and they should be kept in wadding, or chamois leather cases.

Rulers, straight-edges, curves, set-squares, etc., should be made of the best materials, for the stone being perfectly level, and having such a polished surface, enhances the slightest error, which on paper is sometimes toned by its roughness. Steel is a very good metal, and although the student will find it rather more expensive, still, once having invested in steel instruments, he will find them invaluable, and will seldom, if ever, have to buy others; the same cannot be said of wooden ones.

It is presumed that the student already has a knowledge of drawing, and therefore a necessary knowledge of the above instruments and also their use; they are not therefore further described.

In the next paper I hope to finish with the description of the principal various tools, etc., used in lithography, and I shall then be able to at once take up the more interesting subject of drawing on the stone.

SOME MORE HINTS ON FRAMING.

BY B. A. BAXTER.

CUTTING TENONS—CUTTING SHOULDERS—TENONS OFTEN TOO WIDE—WEDGES OFTEN TOO GREAT AN ANGLE—CARE IN FITTING PANELS—IN PUTTING TOGETHER—MITRES TO MOULDINGS—SCRIBING MOULDINGS.

IN former papers on Woodwork, in pages 482 and 646, Vol. I. of WORK, I have chiefly confined my attention to the plane. This tool, however, though very important, and its efficient use difficult to the beginner, is not the only tool upon which it is desirable to give some explanation or assistance.

Supposing that the previous remarks made by the above-signed have been read and understood, and that the verbal description has been translated into "something accomplished, something done," let us now try to finish our framing, which was prepared, set out, and was being mortised. Mortises involve tenons, and it by no means follows that our readers who have profited by the various instructions and advice as to mortises are much helped thereby in the cutting of a tenon. We will, as a preliminary, first examine the mortise-gauge. This we have new and bright, with its lacquer still intact and its polish odorous with benzoin. If so, take care. The steel points of a new mortise-gauge are large and prominent—very tusks, rather than teeth—and our beginners must handle the gauge with care, not using much pressure to score the lines deeply on styles and rails, because, if so, we cannot be sure of the exact line which lies somewhere in that deep ugly score. We who deal with pencil marks and chalk lines are too apt to forget the difference between our lines, so-called, and the "flowing of points," the "length without breadth" of the mathematician.

However, let us make as narrow a mark as possible—just enough for us to see and to cut by. In setting the gauge to the width of the chisel, let us be as exact as we can, and until proficient let us always take the precaution to try the effect on a piece of spare wood, applying the chisel to make sure that we have successfully fixed the points the exact distance apart.

Now, if the mortise is well cut, it will be just the width of the chisel; but it will *not* be well cut if the gauge is set too wide or too narrow. The two gauge lines will be two conflicting masters, and, inexperienced as we are, we shall fail of a good result.

It will not help the fit of the tenon for the mortise to be cut badly. We will suppose ourselves interested spectators while a workman cuts a tenon. He has already marked with a mortise-gauge the lines which are to form the boundary in thickness—equal, as we have seen, to the width of the chisel—and he has also marked the shoulders each side. We notice that he has marked these with a knife or chisel, and not with a pencil, from which we learn that the appearance of the work is worthy of consideration. We notice that he fixes the rail in the bench screw, and, just placing his thumb on the end of the rail, he draws his saw towards him; and, on inspection, we find that the saw has already made a shallow channel for itself just on the edge of the line, the channel itself being outside the thickness of the desired tenon.

We see, too, that he began the tenon at the point farthest from him, accurately to the line, and that he gradually brought the cut to the nearer edge, until, with the same accuracy, one edge of the saw just seemed to scrape the fine line made by the mortise-gauge. Asking him how to manage tenons on long pieces, he tells us that sometimes tenons must be cut on the stools, turning the wood once or twice during the progress of the work. In order to cut tenons successfully, therefore, we must learn the difference between cutting *on* a line and cutting *up to* a line.

Still another point: the saw must not be allowed to penetrate past the shoulder, if the appearance of the work matters at all.

The tenons having been sawn, the shoulders may be cut—removing what are called the cheeks. This is done with the tenon saw, unless in very small work, when the dovetail saw is more suitable. Having the shoulders marked with a knife, we may be allowed to remove a little wood from outside the line, as in Fig. 1.

The line of entrance of the saw is more correctly determined by so doing, and if properly sawn, the joint at the surface is a knife-cut one, as correct as our square or bevel, modified by our skill in using it.

It is most important to exercise care in cutting shoulders that the saw is not allowed to cut too deep, as the tenon would be spoilt by so doing.

I have already said that the proportions of a tenon and its mortise partly depend on what panels, mouldings, rebates, etc., are present; but we ought not to go far from the usual custom of making the tenon about one-third of the thickness of the stuff. As far as the other dimensions are concerned, clearly a tenon right through must be as long as the style is wide; in width, however, we may use judgment.

The present writer has often seen professed workmen make the tenon so wide, that when the work was wedged up and the superfluous wood of the styles cut off, the tenon looked dangerously near the extremity of the style, and the wedge looked like forcing the little piece of wood which retained it right away (Fig. 2).

This leads to the subject of wedges, about which a word or two might be spoken. Our experienced readers are asked to pardon the writer because he wishes to insist on a point so obvious to them. A thick, rapidly increasing wedge does more harm than good, and a young carpenter might do much worse than consult a lathe-man as to the angles which *jam* and those which do not. He will be told that if you want a wedge to hold, like a drill in its socket, the taper must be slight and gradual; while if you want freedom of motion, only obtaining definiteness of position, the magnitude of the angle must be increased.

Wedges, however, as we understand them—of wood, and used for framing—are compressible, and if the tapering receptacle is not cut to the same angle as the tapering wedge placed in it, the compression at the point and the head of the wedge is unequal.

It would, perhaps, be best to have the compression equal, but it would be better to have the compression greater in the interior of the mortise than at the outer edge (at *a* rather than *b*; see Fig. 2).

There is no doubt that this error proceeds from school teaching, in which diagrams of the inclined plane and the wedge are drawn, the wedge generally with an angle about double that of the inclined plane. I distinctly remember being informed (?) that a wedge is really *two* inclined planes fixed together, and my contention that I could see no real difference (as drawn for the boys' instruction) between them, except that the wedge was drawn as an isosceles triangle and the inclined plane was drawn as a right-angled one, the angle opposite the shorter side not being very seriously different in each case. Improved wall-sheets and better illustrations have changed all that.*

However that may be, wedges need not be short and rapidly tapering; but they are still wedges—and are more efficient ones too—if more gradual in the taper.

The wedges for our purpose are usually cut out of the waste wood of the width of the tenon, by which means they are, at any rate, the right thickness. Fig. 3 gives an idea of what I mean.

Panels are often an embarrassment to the beginner—it is so easy to make them other than flat, square, and parallel (by square, the workman means that the angles are right angles).

It is also easy to make the grooves for the reception of the panels the right depth in most places, and yet leave some part of the groove not down to the depth intended.

For each of these faults, greater care is the only and sufficient remedy; and, as practice makes perfect, so the necessity of care only seems to make itself understood when some failure occurs, or, if not actually occurring, its likelihood is pointed out.

That is just the reason why I have called attention to these matters, which, though trifles in themselves, yet are no trifle if they prevent the work from going together as it ought.

In gluing up the framing, we ought not to insert the wedges until the shoulders are in contact, or very nearly so, and wedges ought not in any case to be driven hard—so hard as to smash them—as may be sometimes seen, even in the work of those who ought to know better. Every blow of the hammer ought to be delivered with judgment, otherwise the joints are apt to go up at one corner of each, instead of uniformly, as they ought.

The directions given in my last paper as to setting out the styles may prove useful for gluing up. As may be remembered, the worker was advised to mark out on the edge of the style the outline of the section of the rail; and if the mortise has been truly cut and the tenon just easy, the wedges will give that slight adjustment which will be

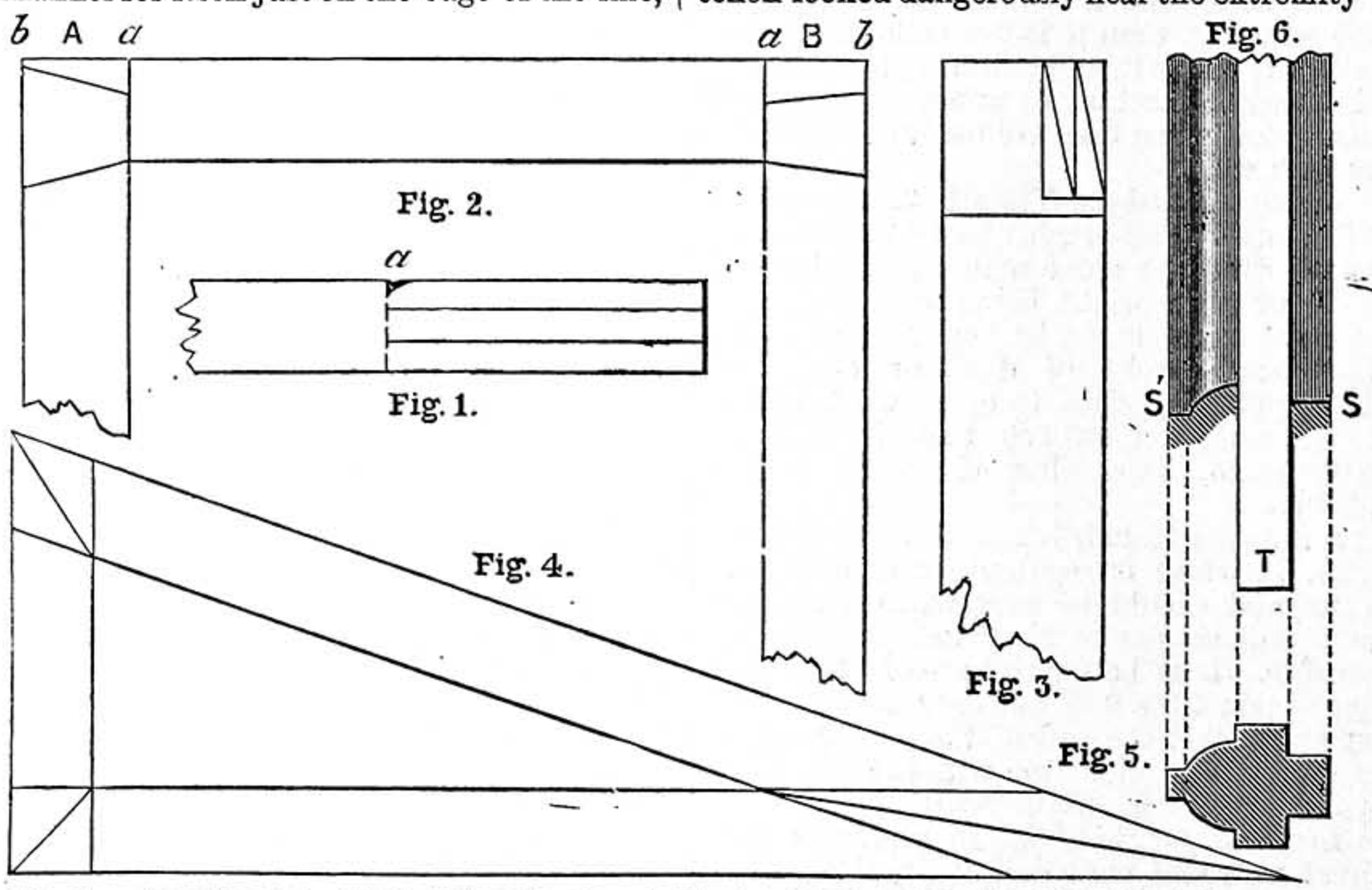


Fig. 1.—Shoulder-cut Black Triangle at *a* indicates Wood removed preparatory to sawing: slightly exaggerated. Fig. 2.—Diagram showing Difference in setting out Tenons and Wedges—A, injudicious; B, much better: not at all exaggerated. Fig. 3.—Tenon formed at End of Rail, showing Method of cutting Wedges. Fig. 4.—Simple Plan to obtain Mitres: Draw Parallel Lines equidistant from Inner Edge of Frame; join Intersections and Angles of Frame. Fig. 5.—Section of a Sash Bar. Fig. 6.—Diagram exhibiting Scribed End of Sash Bar—S, S,' Shoulders; T, Tenon. None of these Diagrams are drawn to Scale.

* I think not. Theoretically, the teaching was, and is, right enough. The positions of the wedge and inclined plane are altogether different. The inclined plane proceeds from a point in, and is inclined to, a *horizontal* line, supposing, for illustration's sake, that the plane is viewed in side elevation or profile. A wedge, mathematically speaking, under the same conditions is formed by two planes proceeding from the same point in, and inclined at equal angles to, a *vertical* line. Therefore, the surfaces of a wedge *are* two inclined planes, nothing more and nothing less. Moreover, the wedge of Mr. Baxter's schoolboy recollection was a mechanical power shown in its best form for splitting and rending, while the wedge of his later experiences is, or ought to be, cut to suit a certain inclination, and is rather a half wedge—the wedge being divided in the vertical line—used for purposes of locking up, gripping, and compression, and not for splitting.—Ed.

sufficient to bring the rail to the exact place indicated by the setting out.

If, as we are supposing, our framing has any mouldings, a word or two on mitres will fitly conclude this paper. Mouldings, to be perfect, ought to intersect, by which is meant that perfect meeting of edges, angles, and curves which makes it evident that their section is alike; or that, if "raking," the section is properly modified, and that the angles at which the moulding is cut are the correct angles. Let us suppose the angles at the corners of our framing are right angles, then the mitres, or angles at which the mouldings are cut, must be 45°. The angles of intersection are very easily drawn on a panelled framing which has mouldings inserted afterwards, as is often the case. All that is needed is a small piece of wood for a gauge, and, moving it round the panels with a pencil in contact, the place of the moulding can be outlined, and by joining the intersections the correct mitre of each angle, however different, will be obtained. (See Fig. 4.)

In ordinary cases, where the angles are (in workshop phraseology) square, the use of a template for all stuck mouldings is all that is necessary. For mouldings that, instead of being mitred, are scribed—as sashes—the use of the template to indicate the portion to be cut away is similar to its use in mitreing, except that in this case only one of the surfaces requires treatment.

We will suppose a sash bar is to intersect with the style or rail (Fig. 5). A little consideration will show that it can either be done by mitreing or by scribing—in the case of mitreing, by using the template as a pattern to cut off the angles to the point of contact at the edge on both bar and rail; in the case of scribing, using the template only on the bar, as an indication of the portion to be cut away, being the counterpart of the moulding on the rail which remains intact. The learner may see from this that mitres require only to be cut at the proper angle, while a scribe requires the use of chisels and gauges of suitable sizes and curvature, according to the style and contour of the moulding.

On the other hand, scribing has the great advantage of allowing some adjustment. For instance, if the bar just mentioned happened to be a trifle thicker or thinner than its fellow by which the rail was set out, if scribed the fit would be equally perfect; whereas, if mitred, every divergence from the size marked on the rail would be unpleasantly apparent.

Leaving our friends to try some experiments in mitres, scribes, and other joinings, and strongly advising them to spend a little time in such practice, I can only hope—what is sure to be the case—that their success will be in accordance with their industry and perseverance.

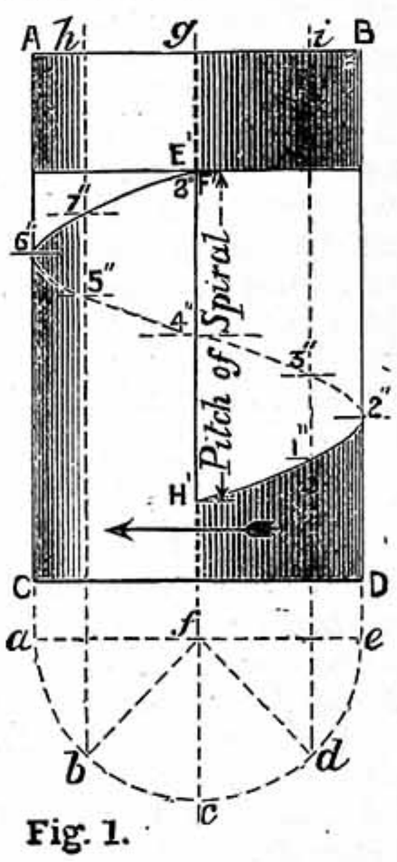


Fig. 1.

Fig. 7.

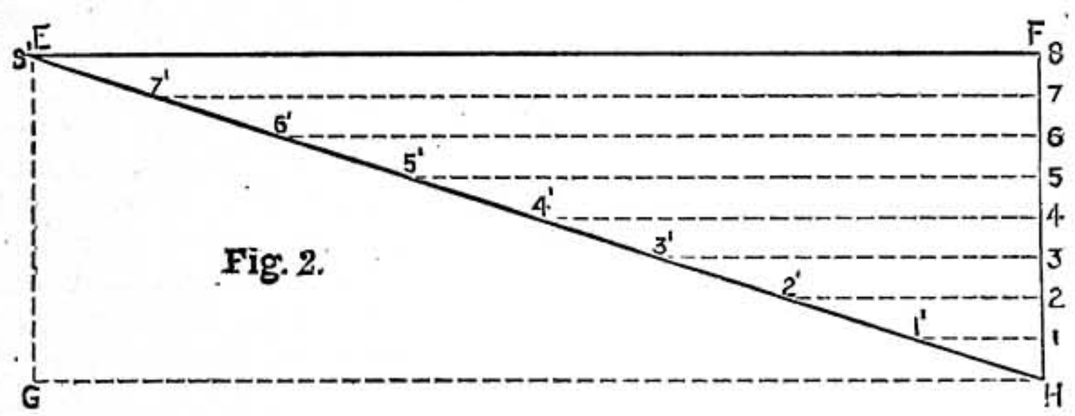


Fig. 2.

Fig. 8.

Fig. 9.

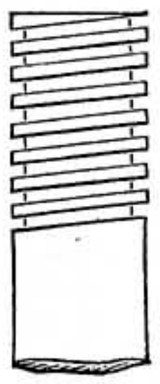


Fig. 10.

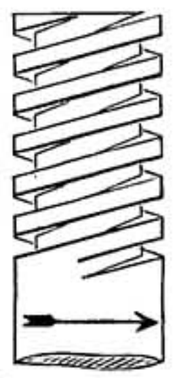


Fig. 11.

Fig. 12.

Fig. 13.

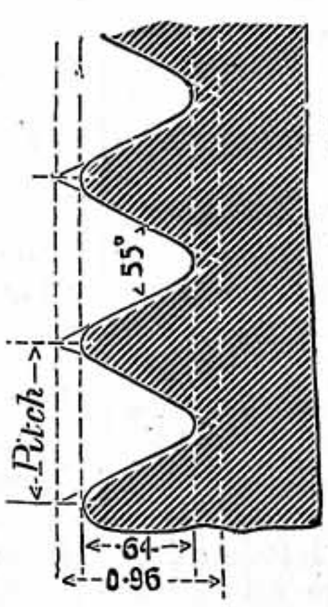


Fig. 3.

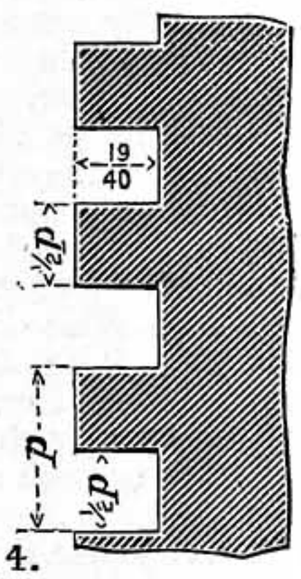


Fig. 4.

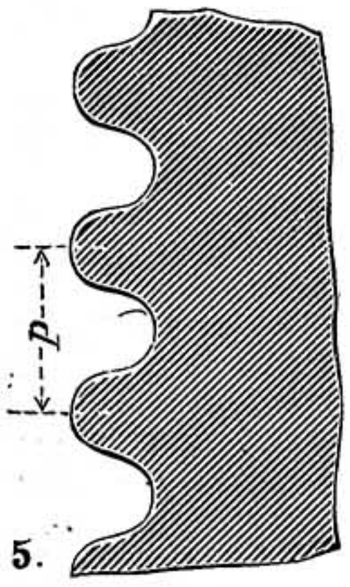


Fig. 5.

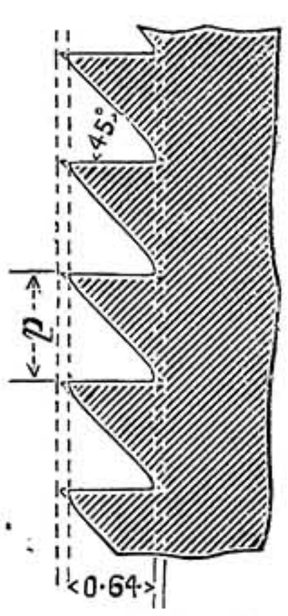


Fig. 6.

Fig. 1.—Formation of Spiral of Screw round Cylinder. Fig. 2.—Diagram showing Increase or Diminution of Pitch. Fig. 3.—Whitworth Screw Thread. Fig. 4.—Square Screw Thread. Fig. 5.—Whitworth Screw Thread, rounded. Fig. 6.—Trapezoidal Screw Thread. Figs. 7 and 9.—Conventional Modes of drawing V-Threaded Screw. Fig. 8.—Ditto, Small Square-Threaded Screw. Fig. 10.—Ditto, Single Square-Headed Screw. Fig. 11.—Ditto, Double Square-Headed Screw. Fig. 12.—Ditto, Double V-Threaded Screw. Fig. 13.—Ditto, Single V-Threaded Screw.

SCREWS USED IN METAL WORK.

BY P. B. H.

THEIR USES—WHAT IS A SCREW?—HOW TO OBTAIN A SPIRAL LINE—DESIGN OF V-THREAD—SQUARE THREAD — TRAPEZOIDAL THREAD — CONVENTIONAL METHOD OF SHOWING THREADS—RIGHT- AND LEFT-HANDED SCREWS—HOW TO DRAW A SPIRAL LINE.

ONE of the—or I might, with perfect truth, say the—most useful pieces of mechanism ever invented is the screw in its various forms. It is employed for such an infinite variety of purposes—in some cases having to bear enormous strains, and in others scarcely any. It is used almost universally (the rivet, its great rival, alone excepted) to hold together two or more pieces of the same or varying metals or materials. It is used as a means of imparting motion in gearing, as in the worm and wheel, the worm being simply a fixed screw turning on its axis. A great many presses are worked by, and owe their great power of compressing substances into small bulk to, the screw, which in these machines is subject to great strains. The breech mechanism of our large and small guns, where the strain is likewise enormous, is kept in position by a screw. Then, again, the fine adjustments of the microscope and the almost inappreciable movements of the measuring blocks in the machine for measuring to the 1,000,000th part of an inch owe their minuteness and accuracy to the screw, which in these two cases is subject to a very slight strain. From these few instances it will be seen between what extremes the screw can be usefully employed. Many others could be given, but the reader himself will, no doubt, recall to mind a number.

In this article I shall confine myself solely to the screws used in metal work, not to those employed in wood.

The forms of the threads vary according to the purpose and the material for which they are employed. I shall show later the principal forms of threads, and the method of drawing them, both conventionally and accurately.

Most readers have some idea of a screw or spiral, but there are, no doubt, many who do not know how to define it and how it is obtained. I once saw, in answer to the question, "What is a screw?": "It is a short pitch spiral"; and in answer to "What is a spiral?": "It is a long pitch screw." This definition gives no accurate information to anyone, though almost everybody has some idea, though faint, of what a spiral is, and that "spiral" and "screw" are used by many persons almost synonymously. Yet the above definition is not quite clear, so I shall endeavour to show how to obtain a spiral line practically, which is, I consider, the best method of impressing it on the memory, as it gives you a very simple way of making one yourself.

Take a cylinder, A B C D (Fig. 1), of any convenient size; then take a rectangular piece of paper, E F G H (Fig. 2), the length of which must be exactly equal to the circumference of the cylinder—that is, the points E G must coincide with F H respectively when the sheet is wrapped round the cylinder. Having got this correct, cut off the dotted portion, E G H, of this rectangle. Take the remaining triangle, E F H, and wrap it again round the cylinder, making F H (Fig. 2) parallel with the axis. The points E and F should now coincide at E^1 F^1, and the line H^1 E^1 in its winding round the cylinder forms a spiral or screw, the pitch of which is equal to the depth F H. The pitch of a screw or spiral is the distance the thread or line rises during one complete revolution. For instance, if you turn the cylinder once round in the direction of the arrow, meanwhile following the line from H^1, it will have gradually risen

from H′ to F′ or E′, which distance, as before stated, is the pitch of the spiral. By increasing or diminishing the line F H (Fig. 2) the pitch is increased or diminished. By this means the pitch can be varied from the smallest fraction of an inch, as in some watch screws, to as much almost as you like, if the body round which it winds is big enough. A good illustration of a long pitch small diameter screw is the egg-whisk, where, by sliding a wooden nut backwards and forwards along a twisted wire shaft, the whisk rotates first in one direction and then in the other. Spiral staircases are the largest pitch screws I can think of. When once the method of obtaining a spiral line is grasped, the student will follow with comparative ease the drawing of screw or spiral threads, as these only consist of combinations of spiral lines.

Unwin defines a screw as "a cylindrical bar on which has been formed a helical projection or thread." These projections, in order to suit the different purposes for which they are intended, are of various shapes, of which the four principal forms are shown in section in Figs. 3, 4, 5, and 6; but the two first only—viz., the V and the square thread—are in very general use. Fig. 3 shows the ordinary V or triangular thread, as used in all English workshops. The use of a common thread was early recognised by our manufacturers to be of the very greatest importance, and as Sir Joseph Whitworth was the first to propose a uniform system of threads, it has received his name. The Americans use a somewhat similar thread, called "the Sellers," after the introducer.

In most books treating on machine design and engineering formula, there are tables giving the pitch or number of threads to the inch for a given diameter of screw.

Fig. 3 shows the method of designing the Whitworth thread. Draw two parallel lines 0·96 of the pitch apart. Set off the pitch on one of these lines, and at the points so obtained form angles of 55°, as shown. Again, draw two parallel lines centrally between the first two, and 0·64 of the pitch apart. The threads where these lines cut them, or one-sixth the depth of the thread, are rounded off at the top and bottom. The rounding off facilitates the cutting of the screw, and renders it less liable to damage.

When these screws are used in conjunction with nuts, they are termed bolts, and one of their drawbacks is that, when tightened in their nuts, as will be seen from the slope of the threads, the greater the force used to screw them up the greater is the tendency to burst the nut.

For wrought-iron pipes a finer pitched screw thread is used, and is known as the gas thread; it does not cut away quite so much of the metal of the tube.

Fig. 4 shows a square thread, and there are, compared with the V thread, so few used that there is no real standard, each screw being designed for its special work; but the pitch is generally twice that of the triangular thread for the same diameter of bolt. In designing it, the pitch is first settled, and this divided by two gives one-half for the thread and one-half for the space, the depth of which is slightly less than one-half—or, say, $\frac{12}{40}$—of the pitch. These square-threaded screws are generally used to transmit motion. The surface of the thread being normal to the axis of the screw, there is with this form of thread no oblique pressure on the nut, as in the preceding (Fig. 3).

Fig. 5 is the same as Fig. 4, only the threads are completely rounded. This screw is employed where it is subject to very rough usage.

Fig. 6 shows a form of screw thread called "trapezoidal," which is used when the screw has to resist a pressure acting in one direction. Here the surface bearing the strain, as in the square thread, is normal to the axis, so that there is likewise no tendency to burst the nut. The method of designing is almost the same as in Fig. 3. Draw a vertical line, and set off thereon the pitch. From each of these divisions draw horizontal and angular lines at 45°. Through the point where the horizontal line from one of the divisions cuts the angular line from the one above it, draw a line parallel to the first one, which will pass through all the inner angles of the teeth. Then, as in Fig. 3, draw two parallel lines, 0·64 of the pitch apart, centrally between the first two lines. These will cut off a portion of the angles, which should be rounded as shown.

Of course, to draw screws accurately in most machine drawings would take up too much time, and it would be almost impossible in some cases, owing to the smallness of the screw. On this account I have drawn Figs. 7, 8, 9, 10, 11, 12, and 13—which show the conventional methods of drawing threads on bolts—of varying size. Figs. 7 and 9 represent the ordinary V-threaded screw, the first (Fig. 7) being delineated by thin parallel, equi-distant, slightly inclined lines. Fig. 9, being larger, shows a short thick line between two fine ones; this gives a much neater appearance to it than if the lines had been the same. Fig. 8 represents a small square-threaded screw, shown by two fine parallel lines for the thread, while the space between the two threads is slightly increased. Figs. 10 and 11 show respectively a single and double square-threaded screw, somewhat larger than Fig. 9, therefore shown in more detail. The threads in these are represented merely by straight lines, but more in detail than in Fig. 8. The method of obtaining the various points from which the lines are drawn will be shown later in the larger scale drawings of how to draw an accurate V and square-threaded screw. Figs. 12 and 13 show respectively double and single V-threaded screws, which are likewise formed by straight lines.

There are, of course, right- and left-handed screws: those I have drawn are all right-handed. A right-handed screw, when turned in the direction of the arrow (Fig. 11), will, if a nut be placed at the end, enter it; a left-handed one would, however, work out. Another simple way of distinguishing between them is: hold the screw vertically opposite you, when if the threads in passing round the body rise from the left-hand side to the right, then the screw is right-handed; if they rise from the right to the left, then the screw is left-handed. The spiral line (Fig. 2) is also right-handed. A good illustration of a right and left-handed screw working together is the adjustable coupling between railway passenger carriages.

Having shown what a screw or spiral is, and how to obtain it—also the various shapes of threads and the conventional way of drawing the same—we now come to the accurate delineation of the threads of a screw, which, however, through want of space in this number, will have to appear later. But as it may, at first sight, seem rather difficult for beginners to grasp the method, on account of the number of construction lines, I will, before closing this paper, show how the simple spiral line H′ E′ (Fig. 1) is drawn.

Divide the pitch H F (Fig. 2) into any even number of equal (in this case eight) parts, numbered 1, 2, 3, etc. Draw horizontal lines through these points, till they cut H E in 1′, 2′, 3′, etc. As H 1 is an eighth of the pitch H F, the line H 1′ is an eighth of H E. It is also true that all horizontal lines, drawn through any of the divisions in the pitch line to cut the diagonal line H E, cut it proportionately to the pitch: for example, the distance H 4 is half the pitch, therefore H 4′ is half the length of H E, the line forming the spiral. Now, the whole of the line H E just completes the circuit of the cylinder while rising the distance H′ F′ (Fig. 1); therefore H 4′, the half of this line, will complete one-half the circuit while rising one-half the distance—that is, one-half the pitch. Therefore, for every eighth of the pitch rise there is an eighth of the line H E wrapped round the cylinder. If, now, we could mark off the points 1′, 2′, 3′, etc., in their respective positions on A B C D (Fig. 1), a line drawn through them would represent the path of the line H′ E′, or the spiral desired. To do this we proceed as follows:

Draw a horizontal line *a e* below the cylinder, and equal to its diameter, as shown (Fig. 1); draw a vertical line *c f g* through the centre of the cylinder, cutting *a e* in *f*. With *f* as centre, and *f a* or *f e* as radius, describe a semi-circle. Divide this semi-circle into four equal parts at *b*, *c*, *d*, *e*—that is, half the number the pitch is divided into. From *a*, *b*, *d*, and *e* set up vertical lines: the lines from *a* and *e* correspond with the sides of the cylinder.

Now, if a complete circle had been drawn below instead of a semi-circle, the vertical construction lines from *b*, *c*, and *d* would have passed through the points of division in the corresponding half; so a semi-circle is all that is necessary for our purpose.

The lower part of the spiral shall commence on the line *c g*, therefore (supposing Figs. 1 and 2 to be in proper relative positions) produce the line H G (Fig. 2) till it cuts *c g* in H′; this will give the starting-point of the spiral, which, in this case, winds upwards to the right: therefore, from *d*, one-eighth of the circumference to the right of *c*, set up a perpendicular, *d i*. Now, as already explained, for every one-eighth of the circumference the spiral travels it rises one-eighth of the pitch: therefore, produce the line 1 1′ till it cuts *d i* in 1″—this gives the first point in the spiral: then produce the line 2 2′ (Fig. 2), till it cuts the side of the cylinder B D—that is, the vertical line from *e*, which is ¼ of a revolution from *c*; this gives one more point in the spiral, viz., 2″. Here let me remark that I have drawn the curve from 1″ to 2″ without any intermediate points, as, from continued practice, I know that it takes some such form. For exercise, however, the readers might subdivide the ⅛ pitch between H 1 and H 2 into any number of convenient parts, so long as they divide the one-eighth part of the circle *d e* into the same number; then set up perpendiculars from them and draw horizontals from the pitch, when extra points would be obtained between 1″ and 2″ to draw the curve more accurately. After passing 2″, the curve commences to wind behind the cylinder.

If the semi-circle *a c e* had been completed, and divided into eight equal parts, the point showing the next division would have been on the vertical line passing through *d*, as before remarked; therefore, to obtain the next point in the spiral, we may make use of this line. We now prolong the line 3 3′ till it cuts *d i* in

3″, three-eighths of the pitch above H″. For the above reason, 4 4′, produced till it cuts *c g*, will give another point, 4″; 5 5′ will cut *b h* in 5″; 6 6′ will cut A C in 6″. The curves joining all these points must be dotted as it winds round the back of the cylinder. To proceed, 7 7′ produced cuts *b h* in 7″; 8 8′, or E, is represented by E′ coinciding with F′. The curve from 6″ to E′ is drawn in full, as it again winds round in the front of the cylinder.

If the readers of this article will thoroughly master the why and wherefore of these proceedings, they will find no difficulty in understanding the remaining portion, which shows how to draw both the V and square-threaded screw, single and double, and which, as before stated, will appear in a future paper.

A MODEL ELECTRO-MOTOR.

BY GEORGE EDWINSON BONNEY.

ATKINSON'S ELECTRO-MOTOR—THE FIELD MAGNET CASTINGS—THE ARMATURE AND ITS BEARINGS—THE BRUSH ROCKER AND BRUSHES—THE COMMUTATOR—WINDING THE ARMATURE—WINDING THE FIELD MAGNETS—FITTING THE PARTS TOGETHER—TESTING FOR FAULT IN INSULATION—A CHEAP GALVANOMETER.

THE small electro-motor shown in the accompanying illustration at Fig. 1 is suited to the requirements of amateurs who have a lathe and employ it in turning parts of machines as a hobby, and who have a fancy for making up pretty little machines for bazaars and exhibitions. It is a machine that will look very well indeed when good workmanship is put into the fitting and polishing of the various parts, and its parts will also require some careful fitting to make them run well. When properly made, it will drive a small polishing or dental lathe, or a small fretwork machine, or a small drilling machine, or even a light sewing machine, with a battery power of some three or four quart cells of a chromic acid type, or the equivalent current from any other source. Full sets of castings and all other requisites are supplied at a low price—3s. 6d. for the castings, and from 1s. 9d. to 2s. for the wire—by Mr. H. Atkinson, 137, Stamford Road, Handsworth, Birmingham.

These castings consist of two malleable iron field magnet sets of cores and bridges, as shown at Fig. 2, each measuring $4\frac{1}{4}$ in. in length by $2\frac{1}{2}$ in. in width; one malleable iron casting (Fig. 3) for the armature, measuring $2\frac{1}{2}$ in. in length by $1\frac{3}{8}$ in. in diameter; two gun-metal castings, $1\frac{1}{2}$ in. in diameter (Fig. 4), for ends of the armature; two brass castings of four-legged spiders for the bearings of the spindle; one brass casting of a pulley, $1\frac{1}{2}$ in. by $\frac{9}{16}$ in.; one brass casting of a smaller pulley, 1 in. by $\frac{1}{2}$ in.; two brass end-pieces, $2\frac{9}{16}$ in. by $\frac{3}{4}$ in. (Fig. 5), to form feet for the field magnets; one brass casting for brush rocker, $2\frac{1}{2}$ in. in length (Fig. 6); two brass castings of brush-holders (Fig. 7); two brass castings of set screws (Fig. 8); castings for the brass nuts, brass tube for commutator, and a strip of phosphor bronze for the brushes.

These having been obtained, we will set about fitting and finishing the various parts and putting them together.

The Field Magnet Castings.—These, as received from the vendor, will be rough, but not so rough as some I have seen—in fact, these are clean and tolerably smooth, but they will require a few touches with a file to make them fit and have a presentable appearance. All nodules and roughness must first be filed down with a flat bastard file. The channel for the armature must next be smoothed with a half-round file, care being taken not to alter the contour of the arches, nor to more than merely smooth the casting. The corners of the cores should now be rounded a little, to prevent them from cutting into the insulating cover of the wire as this is being wound on. The outsides may now be smoothed and the ends trued to make the whole fit well together. The top casting is a little thicker than the under one. The under field magnet casting will have the two brass feet or holding-down pieces, shown at Fig. 5, fitted under each end, and must therefore have two small holes drilled and tapped under each end to receive two small screwed studs, which pass through the flanges of the brass feet and the ends of the lower field magnet castings into the iron of the top casting, as shown in Fig. 9. Similar small holes for set screws, to hold the feet of the spiders, must also be drilled and tapped in each of the corners of the tunnel arches (as shown at Fig. 9) above and below the tunnel at each end, and round-headed brass studs may be screwed to fit these. Thus prepared, the castings may have a coat of Japan black and be set aside to dry.

The Armature is of the Siemens H girder type in one solid casting of malleable soft iron. This must be filed smooth and true at the ends, and the channel also made smooth with a file. The gun-metal end-pieces shown at Fig. 4 will be fitted to the ends of the armature, and these will hold the steel spindles. It will be well, therefore, to take these together. Get two 2 in. lengths of $\frac{1}{4}$ in. steel rod, and turn them down to $\frac{3}{16}$ in., so as to have them true and smooth. Turn the end-pieces smooth, drill a $\frac{3}{16}$ in. hole in the boss of each, and fit one end of each spindle into each boss, then sweat or shrink them in, as may be deemed best. The end-pieces will be secured to the ends of the armature, after being fitted true to it, by small brass studs; holes must therefore be drilled through the end-pieces and into the armature to receive them. The castings are marked with dots where these holes should be drilled. In one of the end-pieces we must drill two extra holes for the ends of the armature coil to come through, and these holes must be bushed with small tubes of ivory or of bone. When the ends are fitted on, mount the armature in a lathe, and true it by taking a very light cut over it, just enough to take off the rough skin. This done, mark all the screws and screw holes to act as guides in putting together, take off the ends, and dress the web and channel with shellac or good sealing-wax varnish, then set aside to dry, ready for winding.

The brass spindles, shown at Fig. 1, fulfil the double purpose of clamps to hold the field magnets together and to form bearings for the armature spindles. These must now be drilled with holes to fit the spindles, holes in each foot to receive the holding studs, and small oil holes in each bearing, then filed smooth, and polished neatly. The projecting boss of one of these bearings must be turned to form a pivot for the brush rocker, which will fit on this like a loose sleeve, and the insides of the spider legs and bodies should also be turned smooth.

The Brush Rocker.—The casting for this is shown at Fig. 6. The hole in the centre must be turned to fit the pivot on the boss of the bearing above-mentioned; then there must be a small hole drilled and tapped in the edge of the rocker to receive a small brass set screw for fixing the rocker on the pivot in any required position. The small brass castings, shown at Fig. 7, must then be turned and filed to the form shown at Fig. 10, to form brush-holders, and these are held in holes drilled through the ends of the rocker. The part from A to B, Fig. 10, is first turned down to $\frac{1}{4}$ in., and a thread chased on it to receive a brass nut. The hole in the end of the rocker is drilled $\frac{1}{16}$ in. larger, and this is to be bushed with vulcanite or a bit of asbestos board, with a collar of the same on each side, to insulate the brush-holder from the rocker. A fairly good bush can be made from a small washer of rubber cut off from the end of a piece of rubber tube, and two collars of thin cloth to come between the shoulder of the brush-holder and the rocker on one side, and the nut and the rocker on the other; but these are liable to be destroyed by oil. The plain end to the right of the chased thread must be pierced transversely with a $\frac{1}{16}$ in. hole to receive the conducting wire, and this hole is met with another, drilled in from the end, and tapped to receive the thread of a binding screw furnished with a milled head, as shown at Fig. 11. The other end of the brush-holder is turned down smooth, a $\frac{1}{32}$ in. slot is to be cut up to the shoulder, one side of the holder filed flat, and a $\frac{1}{16}$ in. hole drilled through both, the lower half of the hole being tapped to receive the screwed part of a brass set screw.

The Brushes are strips of phosphor bronze foil, 2 in. by $\frac{7}{16}$ in., cut from the roll sent with the castings to the form shown at Fig. 12. Six of these strips are placed together to form a pad. The ends at one end are soldered together, and a slot, $\frac{1}{2}$ in. by $\frac{1}{8}$ in., cut through the whole in the middle to receive the adjusting and tightening stud. A set of these are, of course, at each end of the rocker.

The Commutator.—As on this form of armature there is only one coil, the two ends of which are connected to two parts of the commutator, a two-part commutator, made out of a ferrule of brass split into two equal parts, will be required. The piece of brass tube sent with the castings has an internal diameter of $\frac{11}{16}$ in. This is fitted on a boxwood boss $\frac{1}{2}$ in. in width, which is then bored with a hole to exactly fit the spindle at that end of the armature with the wire holes drilled in the end. The ferrule is now to be scribed into two equal parts, and on each side of the dividing lines scribe two more lines, so as to have the three lines on each side $\frac{1}{4}$ in. apart. Through the centre of the two side lines drill a small hole into the boxwood to receive two short brass screws. Countersink the mouths of these holes, and screw in the screws tightly. Do the same on the other side of the commutator. This done, cut the ferrule into two equal parts with an oblique cut as shown at Fig. 13. This is best done with a hack-saw, so as to make a clean cut through the brass into the boxwood beneath. The boss, with its split ferrule, may now be pressed on the spindle, and trued up in the lathe. In pressing on the ferrule, let the inner ends of the oblique cuts coincide with the wire holes in the armature ends.

Winding the Armature.—This is a simple matter. Measure off 60 ft. of No. 20 double cotton-covered copper wire, roll into a hank, and soak for a quarter of an hour in melted paraffin wax, then hang up to drain and cool. When cool, take the armature in the left hand, and the wire in the right. Place

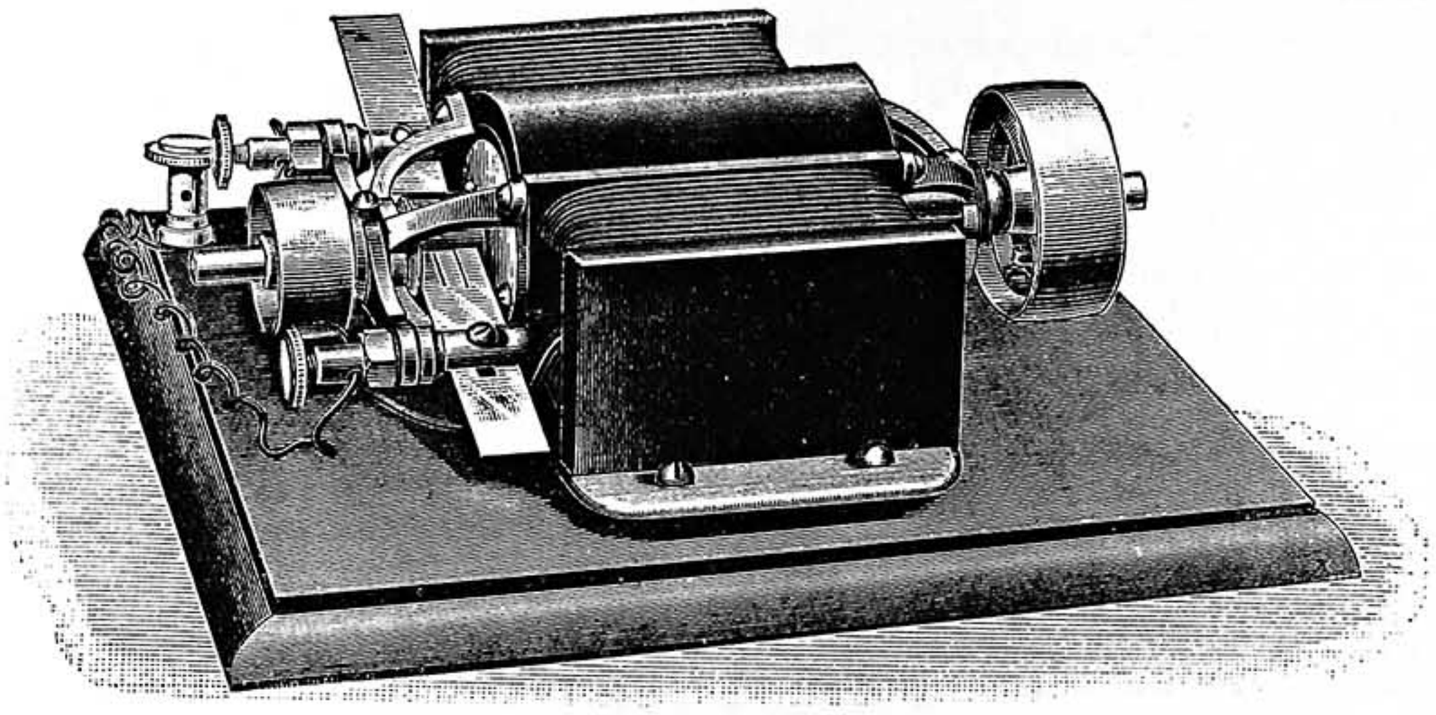


Fig. 1.—Model Electro-Motor: Siemens Bridge Type, complete.

the commencing end of the coil (with 2 in. left free) at the left side of the channel, and hold it down with the left thumb whilst the wire is wound closely around the web of the armature in regular coils, side by side, to the right side of the channel, then back again with the same care and regularity, until all the wire has been wound on in regular and even layers. Then twist the two ends together to keep them from springing apart and the coil from unwinding. Test each layer for insulation as they are wound on, and test the whole coil again when complete.

The end-pieces may now be put on, then the ends of the armature coil may be brought out through the bushed holes in the ends and connected (by soldering each end) to each part of the commutator. The ends should be soldered to the inner edges of the commutator pieces, along which they may lie to the length of ½ in. The coil may now be given a coat of sealing-wax varnish to set the wires; then set aside to dry,

Winding the Field Magnets.—The field magnets of this little motor must be so wound as to cause the arch above the armature to assume a magnetism of opposite polarity to that of the arch below the armature. It matters but very little whether we have a north pole at the top and a south pole at the bottom, or a south pole at the top and a north pole at the bottom, providing both are not north poles and both south poles. This desired end is accomplished by winding the core on one side of the arch in one direction, and the core on the other side of the arch in the opposite direction. Thus, if we wind the left-hand core of the top magnet from left to right overhanded, we must wind the opposite or right-hand core in the opposite direction, namely, from left to right underhanded. This will ensure a north polarity to the upper arch. In commencing to wind the lower cores from the left-hand side, we must wind the left-hand core overhanded and the right-hand core underhanded. This will ensure a south polarity to the lower arch, as shown in the diagram (Fig. 9), if the current is sent through the wires as shown by the direction of the arrows. Wind each core regularly with three layers of No. 20 double cotton-covered copper wire, and test each layer for insulation. When the last turn of wire on each core has been reached, cut off the wire so as to leave 6 in. over and above that needed to make the turn; pass this in under the turn of wire so as to form a kind of half-hitch, and draw this tight to prevent the wire from unwinding; then give the whole a dressing of sealing-wax varnish to secure each coil in their places, and to give the coils a finished appearance.

When the machine is being put together, these coils must be connected together as here described, and shown at Fig. 9. The finish end of the first coil at A must be bared of the cotton covering and cleaned with emery cloth; so also must the commencing end of the second coil on the next core at D. Dip both cleaned ends in some soldering fluid, tin them with a hot soldering bit, twist the tinned ends together with a pair of pliers, then give them a final touch with the soldering bit to solder them together. Each end must be thus treated and connected, namely, A to B, C to D, and E to F. The two ends, C D, may pass down holes made in the motor base, and be connected beneath the base. The two free ends above the upper arch will then go, one to one of the brushes, and one to one of the terminal binding screws on the base, if the coils are to be connected in series with the armature; or both of these wires will be connected to the brushes if the coils are to be connected in parallel with the coil on the armature.

Fitting the Parts Together.—The field magnets may first be fitted together, the ends of the coils soldered and tucked in out of sight, the screws holding the two cores, inserted and screwed tight, and the brass

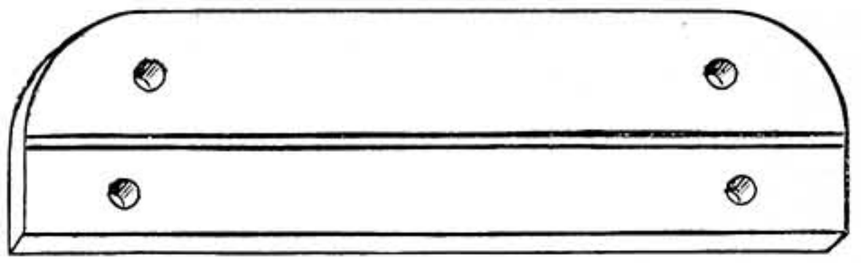


Fig. 5.

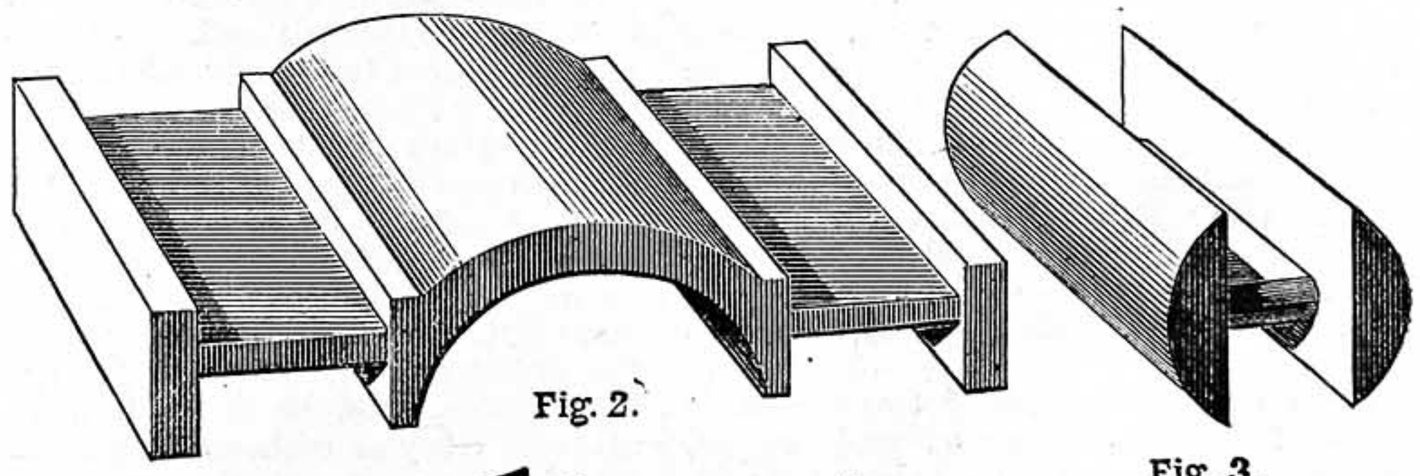


Fig. 2.

Fig. 3.

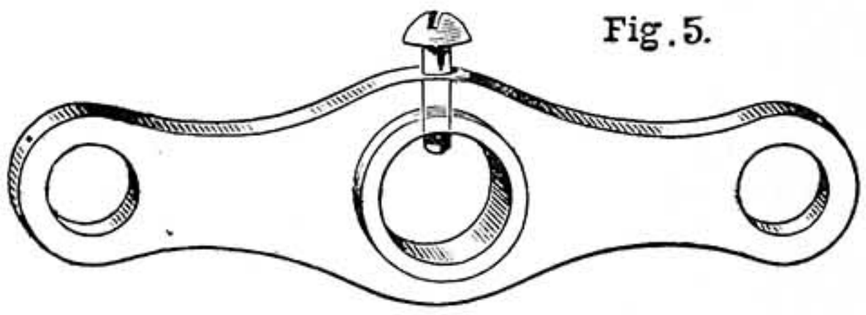


Fig. 6.

Fig. 13

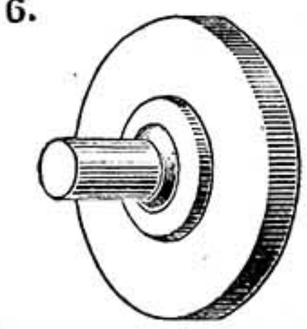


Fig. 4.

Fig. 7.

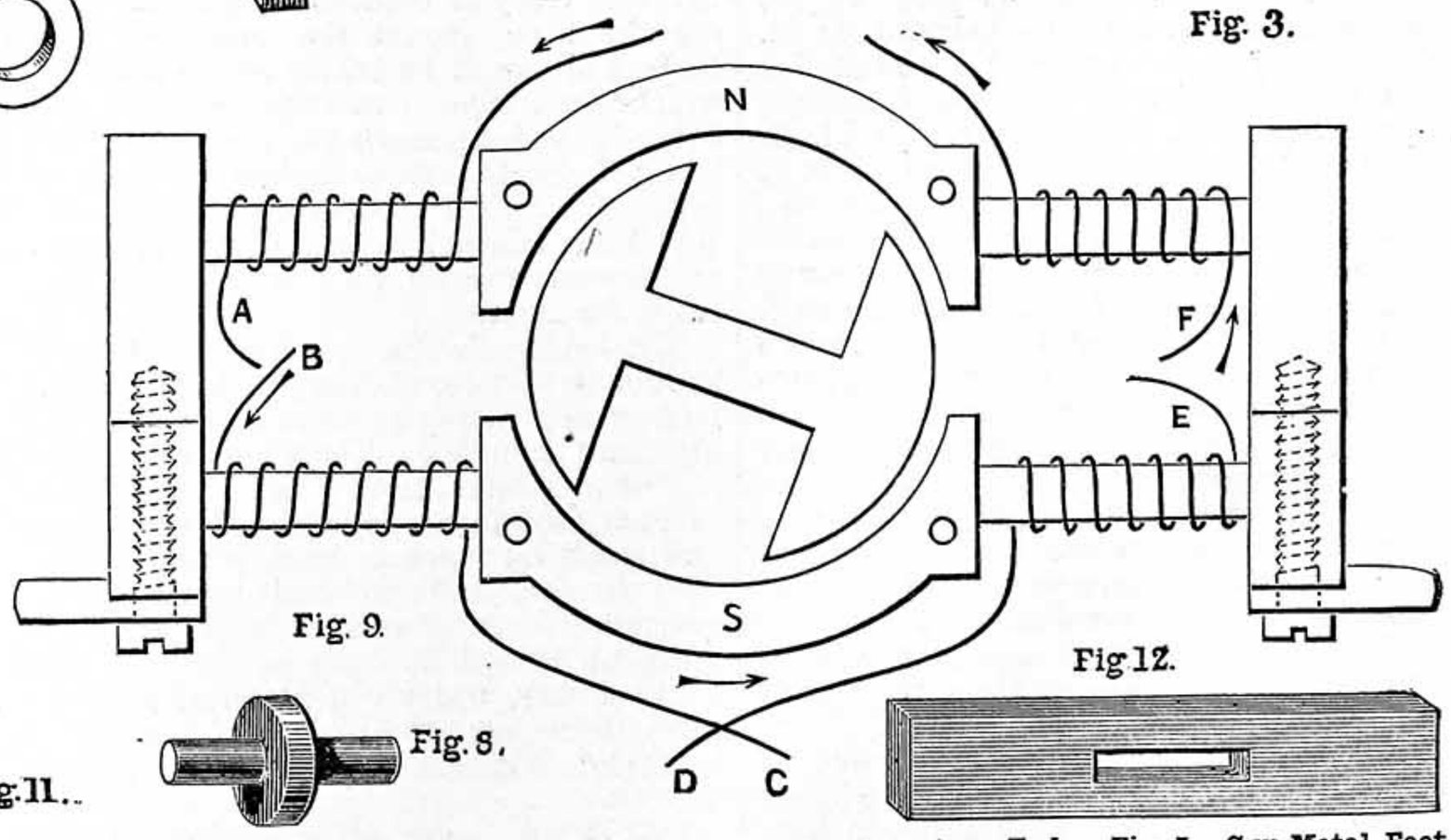


Fig. 9.

Fig. 12.

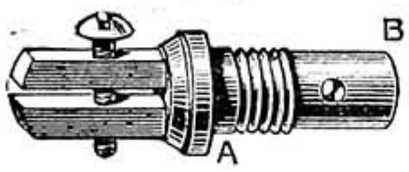


Fig. 10.

Fig. 11.

Fig. 8.

Fig. 2.—Field Magnet Casting of Electro-Motor. Fig. 3.—Armature Casting. Fig. 4.—Gun-Metal Casting for Armature Ends. Fig. 5.—Gun-Metal Foot for Electro-Motor. Fig. 6.—Rocker for Brush-Holders. Fig. 7.—Casting for Brush-Holder. Fig. 8.—Casting for Screw. Fig. 9.—Sectional Diagram of Electro-Motor, showing how it is fitted and wound. Fig. 10.—Brush-Holder complete. Fig. 11.—Brass Screw with Milled Head. Fig. 12.—Brush. Fig. 13.—Commutator.

feet screwed on. We should next fit on the already turned and polished spider bearing to the opposite end from that of the commutator; then put in the armature, slip the other bearing on its spindle, and screw this bearing in its place. Now turn the armature around by hand, and see that it runs true in the tunnel, not touching it anywhere, but parallel with it on all sides. The back pulley should now be fitted on the spindle, and tightened on it by means of a small set screw passing through the boss on the outside. The rocker may next be fitted on, and secured to the outside of the bearing by a small set screw. One of the brushes will have its free end bearing on top of the commutator, and the other brush will press lightly against the under side of the commutator. Their relative positions will be determined by the direction of rotation of the armature, the commutator running off from the brushes, but not against them to ruffle them up. The right angle to set these must be found by experiment. The rocker can be easily moved until the best effect has been obtained, then fixed in this position by the set screw. The smaller pulley is now slipped on the spindle, the armature brought forward until it runs freely in the position where it ought to work, then the pulley must be tightened on the spindle to prevent undue end shake of the spindle in its bearings. A little end play or shake is always admissible, but side shake, due to loose fitting in the bearings, must never be allowed in electro-motors. The motor may now be mounted on a wood base made of oak, teak, or mahogany, and furnished with brass terminals to the wire coils, as shown at Fig. 1. The little motor sent me by Mr. Atkinson is mounted on a polished oak base 10 in. by 8 in., furnished with carved oak legs at the corners, and holding-down clamps of polished brass at the sides. Thus fitted and finished, the price complete is 42s.

As it is advisable to test the insulation of the wire whilst winding it on the cores and armature, we must be provided with a galvanometer of some sort, and a cell of some battery. Almost any battery will serve the purpose. Connect one terminal of the battery to the commencing end of the coil being wound on. Connect the other terminal of the battery to one stud of the galvanometer. To the other stud of the galvanometer connect about a foot of copper wire, and use the bared end of this to touch and scrape the iron on which the coil is being wound. If the needle of the galvanometer is deflected—that is, moves from its position of rest—then the bare wire is touching the iron, and the bare place must be found by unwinding the coil. Cover the fault with a few strands of soft cotton soaked in melted paraffin, or with a bit of silk ribbon, then proceed again. If the galvanometer needle does not move, proceed with the winding, and test again further on. A small galvanometer, suitable for this purpose, is sold by Mr. Atkinson for 3s.

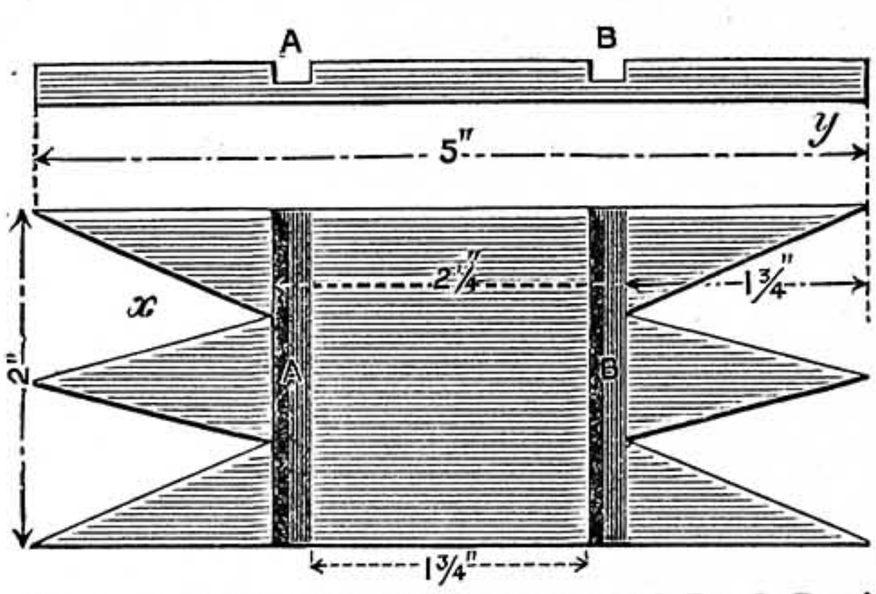


Fig. 1.—Pattern of the Six Parts of which Puzzle-Box is made in Plan (*x*) and Side Elevation (*y*).

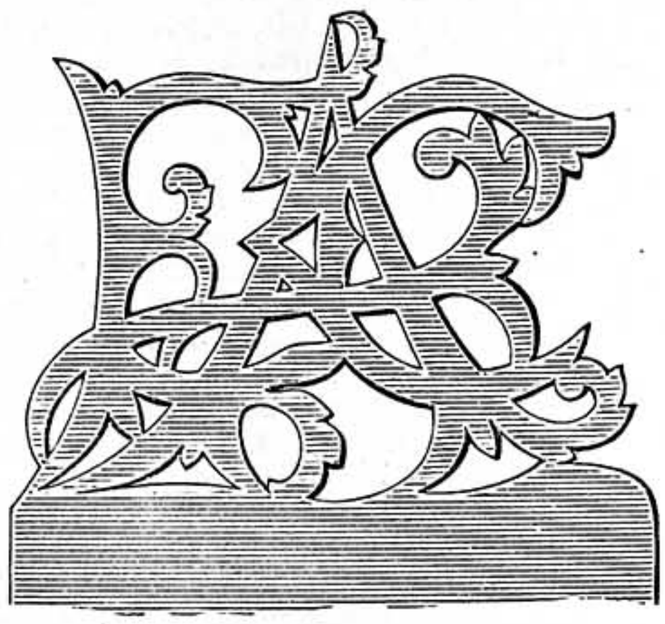


Fig. 5.—Full-size Design for End (Monogram).

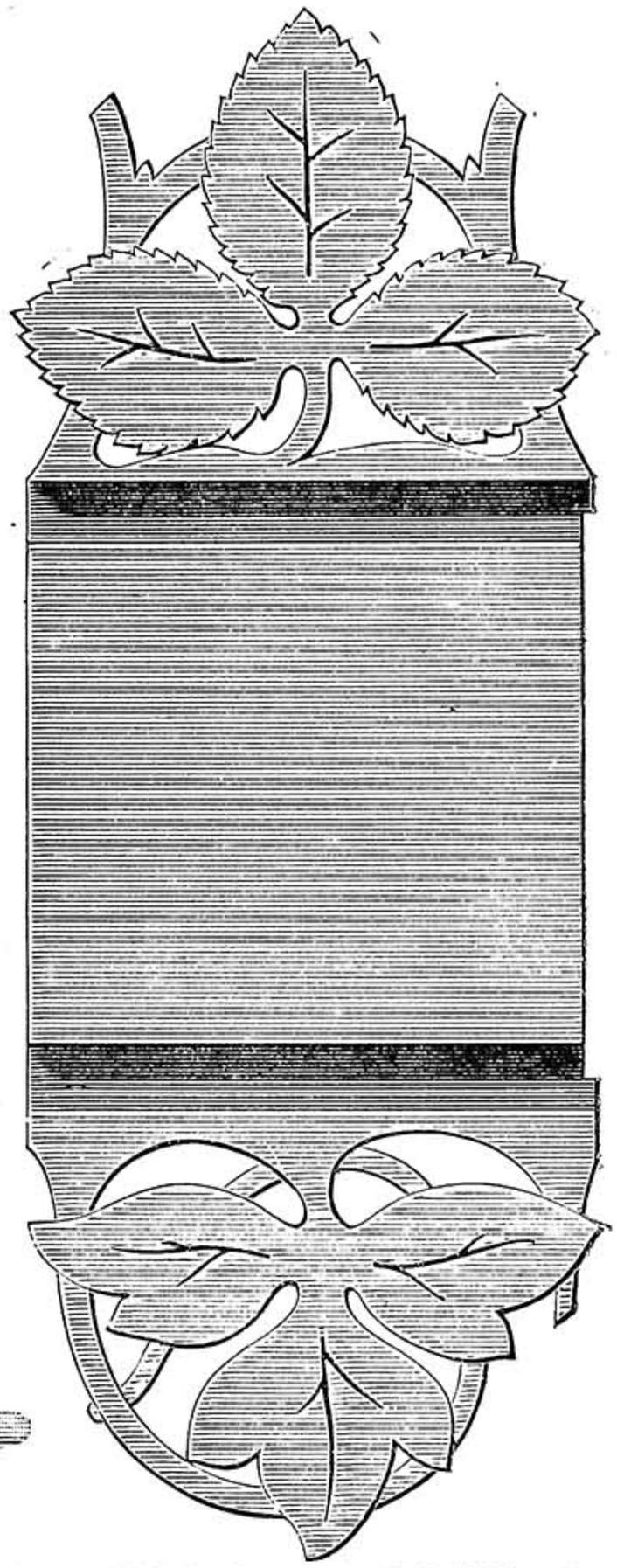


Fig. 4.—Full-size Design for Ends (Foliage).

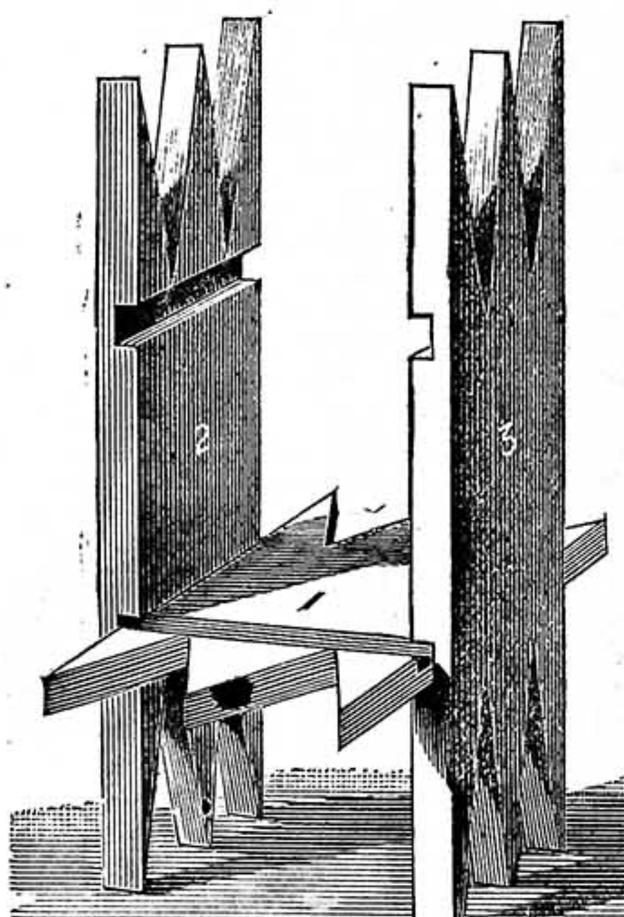


Fig. 2.—Commencement of putting Parts together.

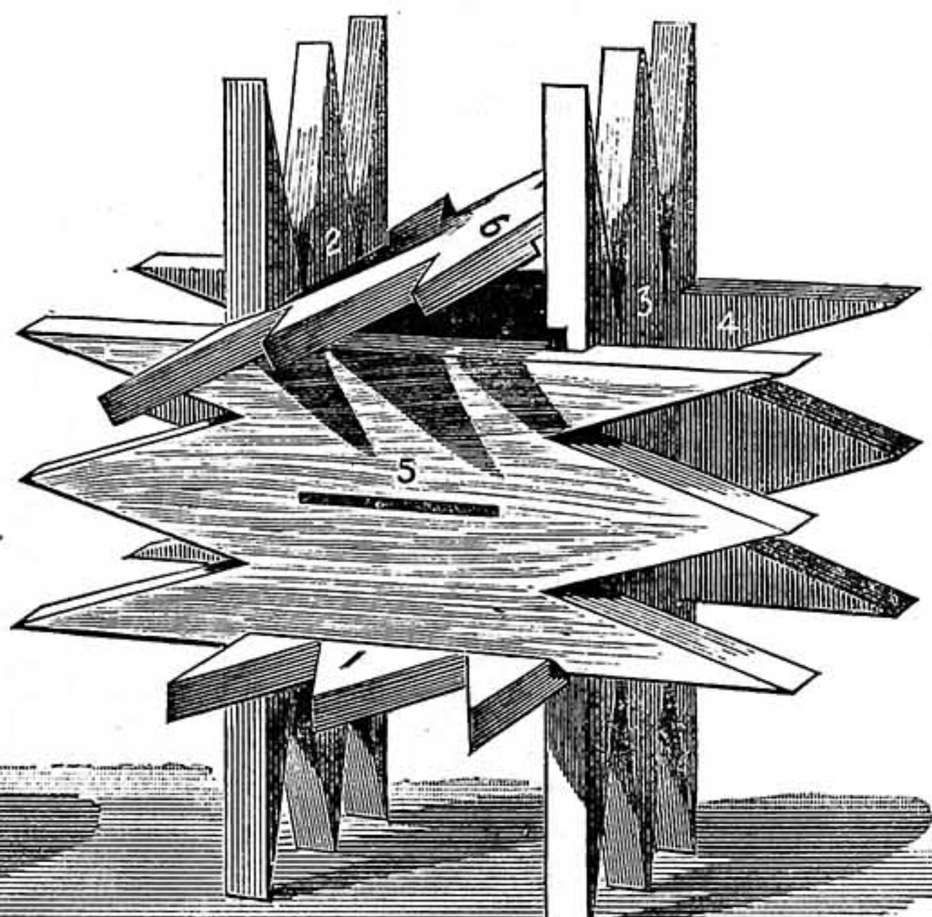


Fig. 3.—Completion of putting Parts together.

HOW TO MAKE A PUZZLE MONEY-BOX.

BY FRED CROCKER.

SETTING OUT THE PATTERN—CUTTING THE ENDS—PUTTING TOGETHER—PUZZLE PICTURE FRAMES.

THE subject of the present paper suggested itself to the writer on being asked to contribute some small article for sale at a bazaar, and, judging by the results, I should think that if any reader of WORK should find the same task put before him, he could not make a more satisfactory and desirable article. The following notes will describe the method of manufacture:—

Procure a strip of wood—Honduras mahogany will do very well for the purpose—2 ft. 6 in. long × 2 in. wide × ¼ in. thick: this must be dry, or the box will soon fall to pieces. Cross-cut it into six 5 in. lengths. Take one piece for a pattern, and set it out exactly as shown in Fig. 1. Groove it at A and B, making the grooves ⅛ in. deep and ¼ in. wide. Cut the ends as in Fig. 1, or as shown in the other designs, Figs. 4 and 5; then make the other five pieces just the same as No. 1, with the addition that one of them will require a slot for putting in the

money. This may be mortised with a fine bradawl and cleaned out with a key-hole saw and piece of glass-paper. The slot should be 1¼ in. long, so that it will just pass a penny, and our box is ready for putting together. The sketches will explain the method of doing this. For clearness, I have numbered each piece. Put No. 1 (see Fig. 2) on the table; add Nos. 2 and 3; then 4 and 5, as shown in Fig. 3; finally put No. 6 in position. Force it down with the thumbs. It will be found that Nos. 2 and 3 will spring sufficiently to allow No. 6 being forced into its place. It will then key all the others; but if the wood is brittle and there is danger of splitting, it may be eased at the side, as shown in Fig. 4.

Figs. 4 and 5 give suggestions for cutting the ends if the reader has a fret-saw. In Fig. 5 it is supposed that the box is to be given to a child, the ends being cut with his or her monogram.

Of course it is not necessary to adhere blindly to the dimensions given. The pieces may be made 2½ in. wide, and the grooves made further apart accordingly, bearing in mind that in all cases the distance from out to out of grooves must equal the width added to the depth of both grooves. Again, the box may be made with the ends plain or simply rounded; and if no better material is handy, the cedar of a cigar-box may be utilised. It is scarcely necessary for me to add that each piece should be cleaned off with glass-paper before putting together.

Puzzle picture frames are put together in much the same manner, each corner being a miniature copy of the money-box.

OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of* WORK *for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of anyone who has a useful article for sale to obtain mention of it in this department of* WORK *without charge, the notices given partake in no way of the nature of advertisements.*

6.—The Indiarubber "Grip" Handle Cover.

Messrs. P. B. Cow & Co., 46 and 47, Cheapside, E.C., send a specimen of their new Indiarubber "Grip" Handle Cover (Caffarey's Patent) for enabling those who use them to obtain a firmer grasp and hold than can be obtained by the hand alone without any intervening medium on the handles of tennis rackets, cricket bats, sculls, handles of cycles, and clubs and sticks for golf, lacrosse, polo, and hockey. The cover is in the form of a bandage with a rough or embossed surface externally, and a smooth surface internally, fitted with a stud and eye at one end, the stud being reversible, so that the cover may be put on so as to bring either surface, as may be preferred, in contact with the hand. Being, as it has been said, in the form of a bandage—the sample before me, intended for a cricket bat, being 36 in. long and 1¾ in. wide—it is wrapped round the handle, starting from the end without a stud, each fold overlapping the preceding one, the operation being completed at the other end by slipping the eye over the stud. It may be said that this new handle cover is entirely free from the objections that attach to the old tubular form of cover, the chief of these being the difficulty of pulling the latter on to the handle owing to its being, of necessity, made somewhat smaller than the handle it is intended to fit—a difficulty "frequently resulting," as the manufacturers point out, "in pinched fingers, loss of temper, and splitting the cover." As a matter of course, that which is difficult to put on is also difficult to remove; and conversely, that which is easily applied can be taken off with equal facility. This gives the new cover an additional advantage over the old one, and enables any cricketer who has occasion to change his bat to transfer the handle cover from one to the other in a very short space of time. The manufacturers claim that the new cover is "most effectual, very durable, and inexpensive." I have no doubt whatever as to its utility and durability; and with regard to its cheapness, it will be sufficient to say that covers for all articles cost only 1s. each, the only exceptions being those for cycles, which cost 1s. 6d. per pair, and scull handles, which are sold at 2s. per pair. They further state that a tennis racket handle cover "may be used for a cricket bat, and *vice versâ*, the only difference being in the length. In the case of oars and sculls, the rower can produce his cover, and apply it to any scull he may happen to use. With golf this is a great advantage, the clubs being frequently changed. The 'Grip' rolls up into the smallest possible compass when not in use, so can be readily carried in the pocket. For cycle handles, which vary so much in size and shape, the same handle cover will fit equally well all sizes and shapes, an advantage hitherto unattainable in any other handle cover. When the old form of cricket and tennis bat handle cover works loose, it becomes practically useless. The 'Grip' never works loose." I do not see, myself, why the new covers should not be turned to good account for augmenting the grip on the handles of pickaxes, hatchets, adzes, heavy hammers, and similar tools. It would obviate, for amateurs, at all events, that salivatory process which is sometimes necessary to assist in attaining a firmer grasp on the handle of a heavy tool that has become polished by the friction resulting from constant use.

7.—Proctor's "Defiance" Writing Inks.

Messrs. John M. Proctor & Co., St. Ann's Ink Works, Nottingham, have submitted samples of the various inks and writing fluids manufactured and supplied by them, and also some dry inks or inks in the form of powder, which can be rendered fit for use in a very short space of time by dissolving the powder in cold water, and shaking it until the powder is dissolved. Having made trial of these inks, I can say with pleasure that they are excellent, and satisfy in every way the requirements that men and women generally are apt to insist on when selecting an ink for their personal use. The most noticeable points with regard to these inks are—firstly, their perfect fluidity, which secures perfect freedom in writing, and enables the writer to skim over the surface of the paper, *currente calamo*, as the phrase goes, and to get a marvellous number of words on the paper with a single dip of the pen. For my own part, I am accustomed to write very fast and very small; and to do this with clearness and legibility one requires a light touch, a fine pen, and ink free from the clogginess, if I may use the expression, that seems inseparable from many kinds of ink, which are so muddy in themselves and contain so much sediment as to render them well-nigh intolerable. The special ink about which I am now speaking is, I take it, the cheapest of Messrs. Proctor & Co.'s inks, being an ink prepared for the use of schools, and supplied in nine-gallon casks at 1s. per gallon. They supply inks that are higher in price, but, as far as I am concerned, I am perfectly satisfied with this inexpensive ink without going to a higher price. Secondly, as the ink is so perfect a fluid, it neither clogs the pen nor causes the formation of an incrustation about it, which soon corrodes it and renders it useless. To go at length into the various inks supplied by Messrs. Proctor & Co. is not possible, owing to their number and variety, but what may be said of one kind may be said of all. The varieties include blue-black fluids for writing and copying, black inks for writing and copying, violet-black ink, inks of special scarlet, bright red—an excellent ink — machine-ruling inks, fancy coloured inks in mauve, magenta, purple, green, blue, and violet; endorsing inks for indiarubber stamps; and multiple writing ink of a violet tint for graphs. The dry inks for mixing with water will be found useful by travellers and emigrants. Prices of the various inks manufactured by Messrs. John Proctor & Co. will be supplied on application. I noticed some little time ago, in Work, a sample board covered with Proctor's "Defiance" Slate Composition; and may now take this opportunity to call attention to Proctor's "Defiance" Slate Paper, faced with the composition for diagrams, drawing examples, etc. The composition does not wash off, and it is said that the paper is so durable that it may be used any number of times. It is sold in two sizes—3 ft. by 2 ft., at 6d. net, and 4 ft. by 3 ft., at 1s. net. The slate paper will be found extremely useful, not only in schools where something supplementary to the blackboard is required, but also in lecture-rooms and class-rooms where the lecturer requires a medium that may be speedily available for the diagrammatic illustration of his remarks.

8.—New Patent Non-Conducting Covering for Steam Pipes.

The Cortex Calorifuge Company, Limited, 3, Fenwick Street (offices), and 19, Hanover Street (works), Liverpool, send me a letter and pamphlet relative to a patent cork covering for steam pipes that they are now manufacturing and supplying, which is known as the Cortex or Cork Covering. The Company's manager, Mr. H. E. L. Grundy, writes:—"We are manufacturing a new kind of non-conductor for the covering of curved or straight steam pipes, to prevent radiation and reduce the consumption of coal, and carry steam a much longer distance, either inside or outside of buildings. The covering is made of pure solid cork, and can be bent to suit any diameter or shape of pipe. The cork is cut into long strips; the ends of each are bevelled, and then joined and coiled into strips of eleven yards. A covering of linen at the back of the cork enables it to be bent and wrapped around steam pipes with the greatest ease. It is a natural non-conductor, and in its wild state has to resist heat, frost, and water, so that it is specially adapted for non-conducting purposes, being so durable and light." Of course, we all know the nature of cork, and are acquainted with many of its adaptations for mercantile purposes; and being well aware of its qualities and characteristics, there is no difficulty in accepting all that Mr. Grundy says with reference to it. Moreover, it is highly commended by various engineers and naval architects who have tested it on the steam pipes of large steamers. It is made to suit various sizes of pipes in strips from ¼ in. to ⅝ in. thick and 1½ in. wide, and is sold by the square foot, and according to thickness, at 1s. 6d., 1s. 7d., 1s. 8d., and 1s. 9d. per square foot. The coils in which the cork covering is supplied are between 11 yds. and 12 yds. long. To fit it on to the pipe, the coil is first unrolled on to the pipe loose, and then lies slack about the pipe. One end of the cork is then secured with string or wire, and the slack is tightened up by wrapping it closely round the pipe. The ends of the cork strips being bevelled and covered with a solution, all that is necessary in order to join them is to press the two ends together and overlap the spare linen backing of the cork which is left at each end for the purpose. When this is done, the cork coil should be overlaid in the contrary direction with a linen tape, specially prepared with a solution which is applied to the inside surface of the linen. This linen, with the dressed surface innermost and touching the cork, or rather, the linen with which the cork is backed, is wrapped tightly and closely round the cork covering, and the operation is completed. In the case of curved pipes, a little must be cut from the edge of the cork on the inside, or the gaps on the outside must be filled in with small pieces of cork covered with linen. A very neat appearance is imparted to the covering by applying a coat of white lead or zinc to the linen envelope. This tends to preserve the linen, which, it should be said, is supplied at the rate of 3d. per square foot.

The Editor.

SHOP:

A Corner for Those who Want to Talk It.

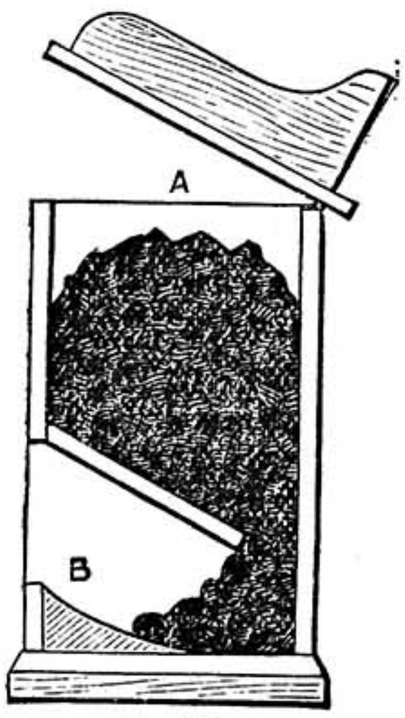
*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Fretwork.—F. C. (*Leytonstone*) writes:—"Some time ago, in a letter to WORK, I suggested an easy method of taking a number of copies of a fretwork design—viz., clamping two pieces of wood together with several sheets of paper between them; then cutting out in the usual manner. This gives you two copies of the design in wood, and as many in paper as you please. Now suppose if, instead of using paper, you place a sheet of thin metal, such as is used for cutting stencil plates, between the two pieces of wood, then cut out, it will make very little difference in the working of the saw, and you will have a stencil plate from which any number of designs may be reproduced."

Coal Box.—H. B. (*Haydon Bridge*) writes:—"I would respectfully suggest to W. H. P. (*Hornsey*) an improvement on his coal box (see page 731, Vol. II.). If he will put the coals in at top (A), putting the top on hinges, he will get more room for coals, and his top will be as available for table purposes as ever. I would also have the floor of the box curved downwards, as at B, so that when the coals were thrown in at A, the box being empty, none would find their way out at the bottom. His idea is a good one. As I use stoves with coke, broken to sizes, according to strength of the wind, I intend making one."



Coal Box.

II.—Questions Answered by Editor and Staff.

Varnish.—D. B. (*Durham*).—As has been frequently stated in the "Shop" columns, varnishing is not a good way to finish furniture of any but the commonest and roughest kind. The best "varnish" is French polish. This you can make by dissolving shellac (6 oz.) in methylated spirit (1 pint). It is not suitable for brush work. Ordinary varnish making cannot be well practised by an amateur. You will find it better and more economical to buy what you want ready made, as you can easily do in your own neighbourhood.—D. A.

Incubator.—T. M. (*Deptford*).—The T-shaped tube and regulator work as sketch, Fig. 1, the parts being lettered as in the original drawing (Fig. 1, page 589, Vol. II.) The difference is, as you will see, that the damper lever must be altered as shown, when the float will open damper instead of closing it, as you imagine. You will economise heat by turning the end of the flue pipe, D, up through the tank, as I have shown, instead of outside, as shown by Mr. Walker. The regulator I recommend is a glass tube filled with mercury and ether (see Figs. 2 and 3). If you can, run the lifting rod, E, up through centre of machine. Fig. 2 is best; but if you place regulator at back of egg drawer, Fig. 3 will be preferable, as the bent arm will project over the eggs. It consists of a glass tube of about ⅜ in. calibre, bent as shown, and the end A sealed over. When obtained, fill the tube sufficiently with mercury, C (shaded dark), then add a small quantity of dilute ether, and agitate the tube until the fluid assumes the position B (shaded light), with a small air bubble at the sealed end A. This operation is difficult to describe, but is easily done when you know how. If you place your forefinger over the open end of tube, and turn it upside down and about a few times, the ether, being of the lightest *s.g.*, will assume the uppermost position, and by a few dexterous manipulations can be confined in the sealed end. This having been accomplished, fit a small float, D, to slide easily in tube. This may be made of a piece of ivory, nicely turned to fit; or a small cork can be fitted. Into this float fit a stiff straw or a piece of fine hard wire, E, to act as the lifting rod actuating the damper; and after testing, cut same to required length. A small bracket, F, made of any sheet metal, with a hole drilled in it to fit rod, will keep it straight and prevent float jambing in the tube. The action is thus:—Ether boils at a very low temperature and gives off a vapour. Being imprisoned, it cannot escape, and therefore forces the mercury round into the long limb. This, in turn, raises the float, and this, with its rod, tilts the damper lever, and allows the heat to pass straight away instead of going through the tank. This will be found a most sensitive regulator, and is the best I know of. I think I have made all clear; if not, write again.

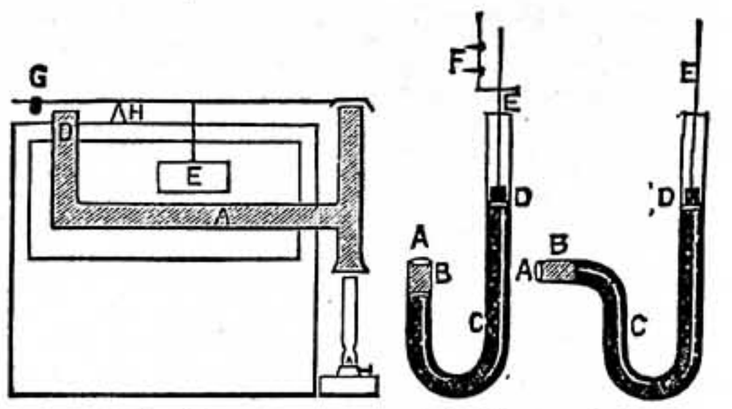
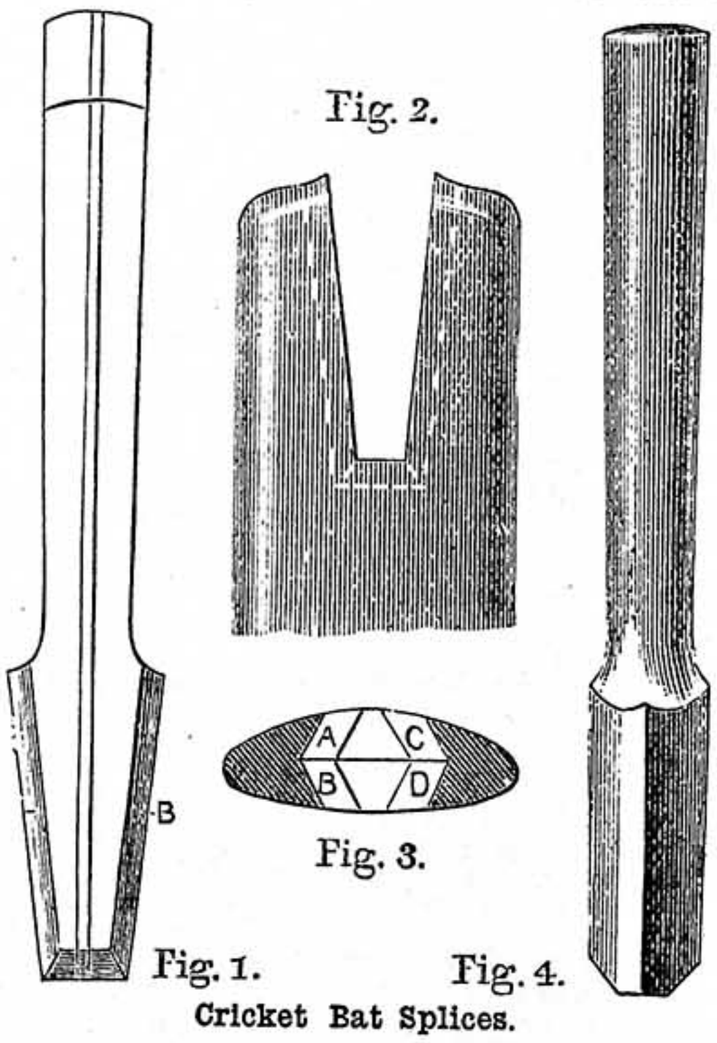


Fig. 1. Fig. 2 Fig. 3.

Incubator Parts.

I cannot suggest any improvement in the damping arrangement described by Mr. Walker *for a hot-water machine*, my remarks as to improved damping being confined to machines of the *hot air* class. Give eggs a sprinkling every day during the latter half of period of incubation with warm water, and during the last day or two a few seconds' soaking in water at about 100° Fahr. will minimise the chance of a goodly number being found "dead in shell."—LEGHORN.

Cricket Bat.—NO NAME.—You do not state whether you wish to make a new spliced bat or want to repair a broken bat. In the latter case, how can I advise you without a tracing of the fracture? In the former, I may tell you that there is considerable art in splicing a bat to ensure a springiness when a blow is struck, so that such elasticity may act as a secondary force. Celebrated makers use pieces of whalebone half-way up the handle, and one-third down the bat to achieve this result. Some make the handle of lancewood; some of willow, which seems the favourite wood for the



Cricket Bat Splices.

bat itself. If I were making a bat, I should have the handle turned of hickory, and left 6 in. longer than I wanted for handle, and then plane it to a wedge shape, as shown in the illustration, marking the bat at the same angle, but cutting it smaller, so that a V-joint is made as shown in diagram in section. This can only be done with a chisel, carefully getting the four surfaces, A, B, C, D, to fit accurately; the end of the handle should be also chamfered off, fore and aft, and the bat itself recessed inwards to receive this V-shaped joint, taking care to make it $\frac{1}{16}$ of an inch too short when in place before gluing, and driving it home when you are satisfied with the fit. If you like to go to the trouble of gluing up the handle first with a strip ¼ in. thick of whalebone between two pieces of hickory before it is turned, you may attain more "springiness." The after-process of stringing the handle will ensure that the joints will not re-open above the splice, whilst the wedging below will compel that portion in the bat to keep close. To add to the springiness, taper the round part towards the lower part of the handle, so that being thinner the spring may date from the junction of bat and handle, and not below, or the strain may shake the splice. Then wind on the string (good fine whipcord well waxed with cobbler's wax is best), and soak the bat with raw linseed-oil, or better still, oil it with raw oil every two days for a month, feeding the butt end with all it will absorb, which will prevent the blows on the bat from the hard ball from even marking it; by well rubbing it with oil thus day by day a very high polish will result. You say you do not like pins, but I strongly recommend, after the handle is housed home and the glue is set, boring with a $\frac{3}{16}$ in. Morse bit two holes right through bat and handle (bored through from the side, of course), and then *rosewood* dowels, $\frac{3}{16}$ in. full, driven right through with thin glue to obviate any tendency of the handle to spring *below* its junction with the bat, which I hold to be fatal.—J. W. H.

Binding WORK.—W. K. S. (*Liverpool*).—You made a big mistake in trying to wash off the glue from the back of sections of the monthly part. The proper method is to scrape them carefully with a knife, which must be used with caution and intelligence. It is possible to make a greater mess with the knife than with the water, but it is possible to take all the glue away if care is taken. There is a certain method of using the knife so as not to cut or tear, which I cannot express in writing, but which I could easily put you up to in five minutes, but you must try and find it out for yourself. Use the knife, and be careful, and you will succeed, I hope.—G. C.

American Clock.—D. H. (*North Shields*).—I cannot help you to design a case, but if you bring the weights down as you suggest, you must allow the pendulum to pass to and fro in *front* of them, and let there be an inch at least between; and bear also in mind that by having a double line, as you suggest, instead of single as before, that your weights must each be double the present ones—that is to say, that as they weigh about 3½ lbs. each now, the ones you make must be about 7 lbs., because each line takes half; therefore there will be 3½ lbs. pulling the clock, and the other 3½ lbs. pulling at the knot where tied up. The drop, of course, must be the same as before.—A. B. C.

Polishing and Burnishing.—G. N. (*No Address*).—It depends on the shape of the articles. Sometimes a leather buff charged with fine emery or crocus is used; sometimes a burnisher, which may be a half-round file ground and polished quite smooth. No special apparatus for turning small wood handle, only dexterity acquired by practice.—J.

Gold Leaf.—TREFALDURYN.—Your note reads as if you had seen a gilder at work (who had already sized the pattern on to a bracket or brackets) take a leaf of transferred gold, and press it over the place where the pattern was already sized in, and being nicely done, when he removed the transfer-paper the design or pattern was left quite clean on the bracket, the transfer-paper retaining all the superfluous gold not taken up by the design. You can obtain every description of tiles of Craven Dunnill and Co., Jackfield Works, Salop. Write for illustrated price lists, stating quantity required.—E. D.

Gas Engine.—L. T. (*Harlesden*).—There is not space in "Shop" to give full instructions for making a gas engine, and partial ones would be useless. The standard work on gas engines is that of Mr. Dugald Clerk, C.E. In reply to your second question, you may certainly put a copper fire-box and copper tubes in an iron boiler; it is a common practice in locomotive engineering.—F. C.

Proportions of Engine.—FAITHFUL READER.—If you will state the parts of the engine for which you require formula, the description of engine, and the work for which it is required, I will send you full particulars.—F. C.

Electric Lighting.—TURBINE.—A turbine is the best motor to use. You should send *full particulars* to some firm of electrical engineers—such as Messrs. Cooper & Paterson, Victoria Street, London, from whom you may get complete information, and an estimate of the cost of an installation, such as the power at your disposal will serve.—F. C.

Book on Electric Bell-Hanging.—JAMES.—"Practical Electric Bell Fitting," by F. C. Allsop. Price 3s. 6d., post free, from Allsop & Co., 165, Queen Victoria Street, London, E.C.—G. E. B.

Wood Carving.—J. M. (*Newport Pagnell*).—It is impossible to give you any very definite advice. You had better find out the best shop where carving is done in the nearest large town, and see if you can arrange with the master to take you on as an "improver." I should think there were good places within reach of you; and if so, you would do better there than by coming to London, unless you can afford to come up for a day or so, and go the round of the shops. Try Rogers, of Maddox Street, London.—M. E. R.

Making Blacking and Ink.—A LABOURER.—As an ordinary paste blacking for shoes, the following is recommended by Dr. Ure:—Ivory black 2 lb., treacle 1 lb., olive oil 4 oz., well mixed together. Add 4 oz. sulphuric acid; and when this has ceased to act on the ivory black, add also ¾ oz. gum Arabic in powder, 5 oz. vinegar, and ½ oz. sulphate of iron dissolved in 5 oz. water. All must then be well mixed together. A cheaper paste than the above may be made of ivory black 1¼ lb., treacle 1 lb., olive oil (or some cheaper oil may be substituted—rape oil or fish oil will do) 2 oz.; well mix into paste with strong vinegar. A liquid blacking may thus be made:—Ivory black 3 oz., treacle 2 oz., sweet oil ½ oz. On these pour ½ oz. sulphuric acid. Afterwards well mix these up with ¼ pint vinegar and ¾ pint water. Or, here

is another cheap and favourite liquid blacking :—Ivory black 2 lb., treacle 1 lb., sweet oil 4 oz., sulphuric acid 4 oz.; to be mixed to the proper thickness with beer bottoms. It may be observed that the use of sulphuric acid (oil of vitriol) in blackings is neither good for the leather or the sewing of shoes. A harness blacking which needs no labour in polishing is thus made:—Gelatine 4 oz., gum Arabic 3 oz., dissolved in ¾ pint of hot water. Strain and place in pan over fire; then add 6 oz. treacle, and afterwards sprinkle in 6 oz. powdered lamp-black. Boil till the mixture thickens, stirring all the time. As regards our ordinary writing inks, they are made of iron (in the form of copperas or sulphate of iron) and of gallic acid (in the shape of nut-galls) boiled in water with a little gum to give body and adhesion. If A LABOURER will get No. 31 (Vol. I., page 493), he will there find receipts for making inks of various colours, with other information on the subject; but we may here give him the rule by which the ink used in the Court of Exchequer, long regarded as of special excellence, was made, and which was divulged before a Committee of the House of Commons:—Galls 4 lb., gum 1 lb., copperas 1¼ oz., and rain-water 4½ gallons. —S. W.

Banjo Matters.—SUSSEX BANJOIST.—The number of brackets you mention (twelve) are not sufficient for a 12 in. hoop. You ought to have at least twenty-four, and not more than thirty. If you use more than thirty brackets you only add to the weight of the banjo, without having any additional advantage. I am not surprised at your banjo not being a success, considering that you have used only twelve instead of twenty-four brackets. You must have enough to pull the vellum tight, for however good a rim you may have, if your vellum is not very tight it will not sound up to the mark. When your vellum is pulled down and fairly stretched, it should feel almost like a piece of board on applying pressure of thumb or finger against it. To get it like that, you must put it on with the band standing well up, and then pull down carefully a little at a time until the top of the band is level with edge of hoop; but as some vellums stretch more than others, the band is often pulled below the level of the edge of rim (or hoop) before the vellum is properly tight. Pulling down the vellum requires care and judgment, not to be taught by written instructions. There is nothing like breaking a few vellums in the pulling down for teaching what ought and what ought not to be done. Never wet a vellum after it is put on the banjo; if you do, and you pull the vellum tighter, you are almost sure of breaking it. I should as soon think of filling the inside of a violin with water as to wet a vellum after it has been put on. The metal to use for hoop is German silver edges spun over steel wires, and lined with oak, maple, or sycamore. It is also important that the band is strong, say about ½ in. deep, ⅛ in. or 1/16 in. thick, and having a recess turned in it to keep the brackets from touching and cutting the vellum; or notches could be filed in to receive the heads of the pulling-down wires, and so keep them clear of the vellum. The longer the handle, and the larger the hoop, the lower and deeper tone you will get, and also more powerful. A banjo with a 20 in. handle and a 12 in. or 13 in. hoop cannot be tuned up to concert pitch, but must be tuned a tone lower; the strings of such a long banjo would not stand if pulled up to pitch. The best and most convenient size will be one with 18 in. handle and 12 in. hoop, or 19 in. handle and 11 in. hoop. A banjo made to this size, and properly strung, can be tuned up to concert pitch to play with piano or other instruments. The higher your bridge, the louder the tone; if you have your bridge too high, you will not feel so comfortable when playing as you would with a lower one. It will give you a better idea which suits you the best if you try two or three bridges of different heights. In starting the vellum when putting on, the pulling-down wires ought to be put on opposite one another, as shown in your sketch, and when you have got them all on, commence to pull down at one, and follow on right round the hoop. After the vellum is on and dry, you must not on any account give one but a turn and then go to the one opposite, but must go to the next one, and so on round the hoop. If you carry out my instructions you will get the proper banjo tone. The great secrets are experience, good workmanship, and the best materials.—J. G. W.

Hammock Chair.—H. B. (*Hammersmith*).—You are not quite clear as to what a rivet is, and what a bolt is. What you want are some ¼ in. bolts and nuts 2½ in. long—that is to say, if you are working in 1 in. stuff—as it will be double thickness; but go to any ironmonger, and you will get them. Rivets are entirely different things, and used for another purpose altogether. I can quite see you had a trouble to get what you wanted if you asked for rivets.—J. B.

Chords for Organette.—R. B. (*Pallas Green*).—This question much resembles one which has already appeared in "Shop," and R. B. would do well to look out for it. I should like to answer R. B. as follows:—The chords possible on an organette depend upon the number and relation of the reeds—in all probability the organette will only play in two or three keys, and the question would be easily answered if this information had been supplied. If R. B. knows anything of music or the tonic sol-fa notation, it would help him, but in ignorance of this, I may say that the keynote chord—that is, the first, third, fifth, and eighth of the scale—is the most useful and important chord. It can be used in any position or inversion, but not at the first and last chord: there, inversions are not to be used. Next in importance is the similar chord founded on the fifth as a root, and harmonising the fifth, seventh, and second of the scale. This chord may also be used in an incomplete form, inverted or rearranged as to the upper intervals. Of still less importance is the similar chord founded on the fourth, supplying harmonies for the fourth, sixth, and eighth. This chord may also be inverted or the upper intervals transposed. Thirds are to be used freely: every chord should have one in its composition, but not always between the same two parts, or minor effects would be produced where least desired. A succession of perfect fifths is not tolerated; even two in succession are objectionable, and fifths without thirds are not pleasant. Octaves are pleasant, but not a continuation of them between the same parts. It is, however, allowable to play a bass part with octaves added below, and a treble part with octaves added above. Here also we need to know the compass of R. B.'s organette. In addition to these three chords, which are subject to many changes of position, giving variety, there are many more artificial chords, sounds for which are not probably provided on R. B.'s instrument.—B. A. B.

Bar Magnets.—W. H. O. P. (*Hackney*).—In London! and yet you cannot get a pair of round bar magnets. Why, I wonder at you! Take a walk down the Strand some Saturday afternoon and look in the opticians' windows, and if you do not get a pair, I'll eat my hat. But if you cannot get them round, you will certainly get them flat. Take the nearest you can get to the size you want and make the holes in the case to fit them. Flat magnets will do just as well as round ones for your purpose. It is not necessary when buying these to state the purpose you have in view. Ask for round bar magnets at any electrician's or optician's, and I am sure you will get them.—W. D.

Blocking, Burnishing, Relief, etc.—JOINT.—(1) A good dry powder for blocking Dutch metal on cards, etc., may be had from Messrs. Berry and Roberts, St. Bride's Street, London, E.C. You might try powdered resin or gum sandarach. Tie in a small muslin bag, and dust over the card. Lift the metal in the stamp, as you cannot "lay on" on the top of the powder. (2) Very likely the want of experience is the cause of your colours looking smeary and spreading, if, as you say, you use the best colours and varnish. But what are they? Use dry colours and white crystal varnish, and grind them well on the slab. Put it on the die with a hard brush, and wipe on hard paper. Do not use turps. (3) I gather that you do want experience. The gold burnishing is done in the way you have been trying to do it. But what in the world do you put the piece of thin copper upon your die for? Allow your work to become thoroughly dry, and re-stamp again and again. (4) Do not be afraid of wearying me. There are different methods of doing relief stamping in two or more colours. One of them is by getting two or more dies, which, put together, make one complete—that is, supposing you want to have J B interlaced, each having a different colour, you get one die with J on it, and one with B on it. You put in B first, and stamp the paper with it, gilding it if you like; then you put in J, with a different colour, and stamp upon the top of B. Of course, the dies are cut specially for this class of work; and when finished, it looks as if it had been struck with one impression. Another method is by painting in the different parts of the monogram on the die, and wiping and stamping in the usual manner. (5) See question 2 for answer to this.—G. C.

Water-Tube Boiler.—GENERATOR.—The tube you propose is very old, and its use has been several times patented in different forms, notably in "Field's" boiler. It would not answer as you have shown it, as there is no provision for circulation. I do not know that the matter to which you refer is patented; that can only be ascertained by a search at the Patent Office, or one of the Public Libraries where the Patent Specifications are kept. —F. C.

Glue, etc.—B. W. (*Walthamstow*).—You should have no difficulty in applying the glue to the dovetails in the ordinary way with a brush. The smaller the work the smaller the brush, and, possibly, the greater the quantity of glue comparatively which may have to be cleared off afterwards. Your second question has revived my expectations of some day getting an inquiry about the correct amount of moisture necessary to stick a postage-stamp on an envelope, together with a request for a full description of the process, or some undertaking of similar difficulty. Run the saw at the speed you find most convenient. If you have steam, the speed will be different from what it will be if you only use foot power and a light machine. The quicker you run the saw the more work you will be able to accomplish in a given time.—D. A.

Sheet Brass.—TIMBRE.—You can get sheet brass of any length, breadth, and thickness you require at Messrs. Warner & Sons, Crescent Foundry, Cripplegate, London, and of Pontifex and Wood, Shoe Lane, London, E.C., and in Birmingham of Messrs. W. Tonks & Co., Limited. I expect the reason you have to pay high is for special sizes of sheets not usually kept in stock. With regard to your second query, you do not say whether the sheet brass to which you refer is "finished" or rough. If it is ordinary sheet brass as it comes from the makers, of course, polishing pastes are of no use, as they will not remove scratches and dents: you must get up a good surface with emery cloth of different degrees of coarseness till you have a smooth surface. It should then be burnished and rubbed up with a leather, and as to the colour of it, that depends on the mixing of the metal; no process of cleaning or polishing will alter that. Articles of cast brass can be to some extent altered in colour by dipping in aquafortis or a mixture of aquafortis and other acids, but this I expect would not be applicable to the articles you make. In reply to your third question, there are several lacquers or enamels of the kind you require. One is called 'Zapon; it is of American origin, and it can be procured from the Frederick Crane Chemical Company, Newhall Hill, Birmingham. It is stated to be far superior in lustre, transparency and tenacity to lacquer, and much easier of application, and to be proof against damp, salt air, fly speck, etc. There is also the patent Silico enamel, which the advertisement states is used for protecting bright, polished, or plated surfaces, without altering the appearance, to be invisible, washable, and durable; not sticky or greasy to the touch. To be had in 1s. bottles of the Patent Silico Enamel Company, 118, Crawford Street, London, W. Messrs. Townshend & Thompson, brass founders and art metal workers, Ernest Street, Birmingham, advertise their goods as sent out covered with a perfectly transparent enamel of greater permanency than ordinary lacquer. But whether it is the same as Zapon, or whether they would supply it to you, I cannot say, but a letter would no doubt receive their attention.—R. A.

Brass Casting.—SHOPMATE.—Plaster of Paris is not suitable for ordinary brass casting—proper venting being impracticable. It is used in type-founding. To cast brass you must mould in sand, and the best way is to get a small quantity from a local founder. Several articles would be required to give sufficient information to enable you to do brass casting; these will be forthcoming when some other sets of papers are concluded.—J.

Veneer.—A. W. (*Manchester*).—The ebony knife-cut veneer you will get from W. Daniel, 77, Church Street, Shoreditch, E.C.—A. J. H.

Developing Prints.—PHOTOGRAPH.—First prepare three solutions—one of neutral oxalate of potash, one pound, to three pints of hot water slightly acidified with sulphuric acid: call this A. Another. Protosulphate of iron, one pound, to a quart of hot water, and add half a drachm of sulphuric acid: call this B. Another. Bromide of potassium, one ounce; water, two pints: call this C. These solutions keep well separately, and must be mixed just before use. To develop: In a suitable tray, place six ounces of solution A, one ounce of solution B, and half a drachm of solution C. Mix in order given and use cold. After exposure, soak the paper in water till limp; then immerse in the developer avoiding bubbles. The image should appear slowly and should develop up strong, clear, and brilliant. When the shadows are sufficiently black, pour off the developer, and flood the print with water to which acetic acid has been added in the proportion of half a drachm to the pint; pour this off and repeat two or three times, using fresh acid water each time; then rinse well in pure water, and immerse for ten minutes in a fixing bath, made of three ounces of hyposulphate of soda to a pint of water. Wash for an hour or two in several changes of pure water and dry. With regard to exposure, very much depends on the density of the negative and light. An average negative, held about 18 in. from a No. 4 Bray gas-burner shielded with ground glass, would probably require about ten or fifteen seconds' exposure. The exact time must be obtained by experiment. Some negatives are done in two or three seconds, some requiring as many minutes. As a rule, a thin negative gives the best result with bromide paper; very dense negatives are quite unsuitable.—D.

Cycle Construction.—A METAL WORKER.—This correspondent would like to see in WORK papers on Cycle construction, particularly the "Safety." Let him refer to WORK, No. 107, where there is a full description of how to make a "Safety" bicycle. As to cycle repairing, I shall continue to tell any inquirers all I can to help them on in putting to rights their own machines.—A. S. P.

Simplex Dynamo.—T. H. (*Farringdon Road, E.C.*).—The dimensions of the No. 1 Simplex dynamo solid armature, described on page 758, Vol. II. of WORK, are given on the same page in the "List of Dynamo Electric Machines—Simplex Type." It is 3½ in. in diameter by 2 in. in depth. —G. E. B.

Gold Transfers.—A NEW READER OF "WORK."—This correspondent will get the transfers from Iliff and Son, publishers of the *Cyclist* and *Photography*, 12, Smithford Street, Coventry.—A. S. P.

Industrial Exhibitions.—REX.—You cannot do better than watch the advertisements in the daily papers. All exhibitions are well advertised beforehand. There is one coming on at Glasgow.

Glass Embossing.—G. N. (*Stratford, E.*).—You wish to know if there is anything you can add to fluoric acid to give a ground appearance to etched glass, and you do not want to use the gas process. There is nothing I know of that you can add to the acid to give the effect you desire. The gas would do so, but as you do not want to use that, the only thing you can do is to grind it afterwards with powdered emery. If you wish for a very fine grain get the finest flour emery, put it in water, let it

settle, then pour off the water gently, and use the top strata, which will be finer than the bottom, the coarsest grains settling first.—W. E. D.

Camera Lens.—F. H. (*London, S.E.*).—The lens is probably an old quarter-plate combination, but it is impossible to give any definite opinion without a careful examination. As to the size of camera suitable—probably a quarter-plate camera; but it is easily ascertained if the lens is fixed in one end of a box and a piece of ground glass with lines ruled upon it, representing the different sizes of pictures, is held so that the image from the lens falls accurately upon it. When the image is seen sharply defined, note must be made of the space covered.—D.

Slide Rest.—AXLE.—If AXLE wants a thorough good compound slide rest for a 5 in. centre lathe, he had better write to Mr. William Gladstone, Stafford, where he can get a set of castings for 8s. 9d.; or if he still desires to make his own patterns, he can procure a tracing half size for five penny stamps.—T. R. B.

Taking Out a Patent.—R. W. S. (*Leeds*).—The claims as sent would not be allowed, as they contain what would be held to be only coverable by a trade mark. If a provisional specification is to be put in, it requires to be very carefully considered and prepared both as to the title and the description, supposing it is intended to obtain a valid patent, and one that the law will support. If a provisional is lodged as the first step, drawings should not be included. In the complete specification, all that is recorded in the provisional and covered by the title may be enlarged upon, but no new part not covered by or included in either can be introduced without vitiating the patent. All must be strictly confined to what has been foreshadowed in the provisional. The article in WORK which R. W. S. should read and study is that contained in No. 44, Vol. I., page 694, and no protection in any colony or foreign country can be applied for or obtained in Great Britain. Each colony and foreign country has its own laws, rules, and regulations, independent of all or any in force here. The cost of a patent entirely depends on the amount of work in the shape of skill, knowledge, time, and ability required and called into action in preparing the documents, and doing all that is needed in a proper and efficient manner. A patentee must get his documents recorded in the Patent Offices of each country which has joined the convention before the expiry of seven months from the date of his application in Great Britain, if he intends to patent abroad. If an invention is patented only in Great Britain, any colony or foreign country may—*i.e.*, persons residing in it—manufacture and sell the same if the inventor has not protected his rights within the time specified. A valid patent can be obtained in America after the application for a provisional has been made here, provided the patentee protects his rights there within the time required by the convention, and sell the same when obtained. Of course it is to be assumed that R. W. S. has carefully ascertained whether his invention is novel, useful, and not in use or described before; otherwise he would only waste his time and money applying for and obtaining what would be of no good when patented, as the British Patent Office makes no investigation as to these points, but grants the patent entirely on the declaration of the applicant that he is the "true and first inventor," and that the invention is "not in use, to the best of his knowledge and belief." It is of the first importance for R. W. S. or any other intending patentee to be certain on this point, in order to prevent waste of money, time, and trouble, and experiencing the disappointment which inevitably attends on neglect of proper and needed precautions. Above all things, R. W. S. should avoid attempting to obtain a valid patent by his own unaided exertions. To do work of this kind as it ought to be done requires nearly a lifetime of practice and experience and extended practical knowledge and skill, which rarely, if ever, falls to the lot of inventors and would-be patentees to have acquired.—C. E.

Carvings.—J. C. (*Belper*).—If you want carving patterns for the decoration of ordinary household furniture, you will only be able to get them from some friendly carver who may be willing to exchange with you or sell you some, as there is no regular supply of them, nor, so far as I am aware, are any published for sale. If you only want small carving patterns for fancy articles, you will be able to obtain them from Harger Bros. or from Zilles. Those published by the former would probably suit you best.—D. A.

Wheel.—J. B. (*Tyldesley*).—You can make a lead wheel by casting from a pattern; you can make a wooden wheel, and glue and peg leather around it for buffing; and you can get an emery wheel from a score of firms—say, Sterne, of Glasgow; Lloyd, of Steelhouse Lane, Birmingham; or of any tool merchant.—J.

Wheels.—J. F. (*Leeds*).—You can always tell which is driver and which is driven, by bearing these two fundamental rules in mind:—(1) In a *simple train*, the pitch of the guide screw bears the same ratio to that of the screw to be cut as the number of teeth in the driving wheel bears to the number of teeth in the driven wheel. (2) In a *compound train*, the pitch of the guide screw bears the same ratio to that of the screw to be cut as the *product* of the number of teeth of the driving wheels bears to the *product* of the number of teeth in the driven wheels. It does not matter which of the driving wheels goes on the lathe mandrel. Certainly the driving wheels do not gear into one another. A driver gears into a driven, and in a compound train the second driver is on the same stud as the first driven. For taper turning, you swivel over the top slide of the compound rest.—J.

Machine Design.—T. W. (*Manchester*).—The best is Professor Unwin's "Elements of Machine Design," published by Longmans.—J.

Steel.—J. S. B. (*No Address*).—The best place that I know of for getting tool steel at reasonable prices is at Messrs. Pfiel, Clerkenwell.—J.

Model Yacht.—A. A. B. (*Brighton*).—I must point out that E. O. N. asked for directions for making a model yacht, whereas you ask for a design for same. I would explain that Fig. 1 herewith answers your wants. R is the rudder, which is exaggerated somewhat; M is the mainsail; F, the foresail; J, the jib; and T, the gaff topsail. In a breeze, a jib-headed topsail (shaped like the jib with no yard attached) is hoisted in lieu of T. The best plan as to sails is to get the boat built, sparred, and rigged, then hoisting the gaff into position: the sails are readily cut out in newspaper as patterns. Do not stretch the sails along their respective spars, but allow them to stretch with the wind, and pull out the slack from time to time afterwards, as required; and if the main and gaff topsails show any tendency to "belly," the upper sides may be hollowed slightly to flatten them. The jib should have a cord run along its foreside (like a piping cord), so as to take the strain in hoisting; and the jib must be hoisted tight. Your want No. 2 is sufficiently met in Figs. 2 and 4, at page 652 of No. 92, the overhang of counter being lengthened or reduced, according as the club rule under which the boat is raced enforces water-line or overall measurement; and as to your want No. 3, you will find the sections given at Fig. 2 herewith will, if followed, turn out a very presentable craft. *x x* give the midship section; 1 and 2 are placed about equidistant between *x* and the stem; 6 is under the counter; while 5 is just at the foreside of the stern-post; and 3 and 4 are placed about equidistant between *x* and 6. Finally, you will scarcely find two model yacht sailors agree as to the best form of hull, and to become a successful hand one must not be afraid of experimenting; and indeed, herein lies the chief pleasure of the pastime.—W. H. M.

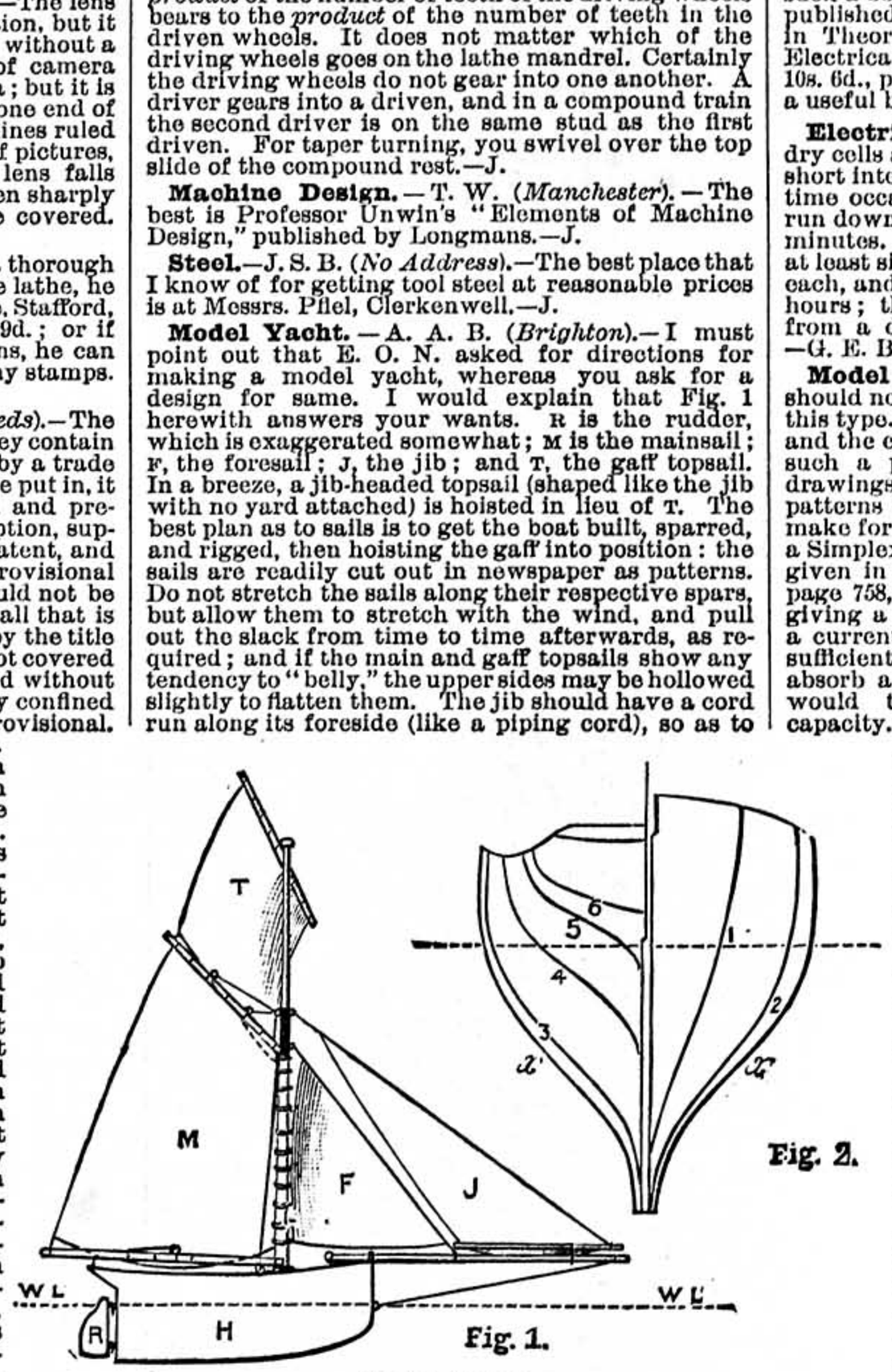


Fig. 1.

Fig. 2.

Model Yacht.

Soap Making.—D. W. (*Liverpool*).—An article on the above subject appeared in WORK, No. 103. It contains all the information you ask for.

Bent Iron Work.—IRONSIDES.—There is no particular instruction requisite, only to learn the art of bending graceful curves with the pliers, and holding them securely to one another with clips. It is a pretty branch of amateur work, requiring only a pair of tinmen's snips, and two or three pairs of round and flat-nosed pliers. The wire is cut from sheet iron of thin gauge. A very little practice will enable you to turn out neat work.—J.

Unpickable Lock.—APPRENTICE.—Try Chubb and Co., or any well-known lock-maker in London, for an unpickable lock.

Books on Dynamo Construction.—APPRENTICE.—"The Dynamo: How Made and Used," by S. R. Bottone, Wallington, Surrey, post free from the author for 2s. 6d.; "How to Make a Dynamo," by A. Crofts, Dover, Kent, price 2s., post free from the author; "Practical Dynamo Building for Amateurs," by F. Walker, price 2s. 1½d., post free from Iliffe & Co., 3, St. Bride Street, London, E.C.; "The Dynamo," by W. B. Esson, price 7s. 6d., Whittaker & Co., Paternoster Square, London; "Dynamo Electric Machinery," by Prof. Thompson, price 10s., Spon & Co.—G. E. B.

Book on Electrical Engineering.—APPRENTICE.—There cannot be said to be any *best* book on electrical engineering. The nearest approach to such a book is "Electricity in the Service of Man," published by the proprietors of WORK. "Electricity in Theory and in Practice, or the Elements of Electrical Engineering," by Lieut. Bradley, price 10s. 6d., published by E. & F. Spon, London, is also a useful book on the subject.—G. E. B.

Electric Night Light.—APPRENTICE.—Gassner dry cells are suitable for lighting up a 3 c.p. lamp at short intervals of not more than five minutes at a time occasionally during the night, but will soon run down if frequently used on intervals of fifteen minutes. An 8-volt lamp will require a battery of at least six large Gassner cells; these will cost 4s. 6d. each, and furnish current (for this purpose) for fifty hours; then they can be re-charged with current from a dynamo, and their power thus restored.—G. E. B.

Model Gülcher Dynamo.—APPRENTICE.—I should not advise you to attempt making a model of this type. The tracing you send is an excellent one, and the extracted data most suitable to accompany such a picture, but you would require working drawings of a reduced design to enable you to make patterns for the castings, etc., and these I cannot make for you. Far better choose a Manchester or a Simplex as a model, and work to the instructions given in my papers on "Model Electric Lights," page 758, Vol. II. of WORK. A 360 Watt machine, giving a current of 60 volts pressure, would yield a current volume of 6 ampères, which would be sufficient to furnish 100 c.p. in electric light, and absorb a little over ¼ h.p. The 5 ampère switch would therefore not have sufficient carrying capacity.—G. E. B.

Barometer Tube.—COCKER.—Gauge-glass tubes will crack in a similar manner after being polished inside with a wash-leather mop. The cause is probably due to an electrical condition of the glass, due to the friction of the leather pad. Use a brass wire instead of iron wire, and put a clip of brass wire in the end of the tube after cleaning it. Perhaps some reader of WORK will kindly suggest some other remedy. Do not make a hole in the wash-leather bottom of the cistern. If you do this to admit air, it will be ruined, as the mercury will come out through the hole. The atmosphere presses on the wash-leather, or "kid leather," and this presses on the mercury. As the barometer tube fits tightly into the wooden box, this is air-tight, and its upper part is a vacuum, when the tube with its column of mercury is fixed in position.—G. E. B.

Electric Bell Wires.—COCKER.—No. 32 B.W.G. copper wire is much too fine for use in the construction of electric bell coils. The smallest useful size is No. 24. Are you sure of the size sold you by the dealer? He must have been either a fool or worse. I do not say that this size cannot be used in constructing a bell, but it must be a very small one, and would need several battery cells to ring it. The wire is quite useless for the coils of a 5 in. bell. This size should have magnet cores 3½ in. by ⅝ in., fitted with bobbins 3 in. by 1¾ in., and wound with No. 18 silk or cotton-covered copper wire. Use at least three cells of the largest Leclanché size as a battery.—G. E. B.

Gold and Silver Solutions.—G. V. (*Esclairmonae*).—To detect the presence of gold in a solution of cyanide of potassium, place in it a strip of clean bright zinc, freshly scoured. In a short time some of the gold will be precipitated on the zinc, and may be known by its colour. To detect the presence of silver in a solution of cyanide of potassium, place in it a strip of bright copper, freshly scoured. In a short time some of the silver will be precipitated on the copper, and may be distinguished by its well-known whiteness. To recover gold from its solution in cyanide of potassium, heat the solution, and drive off the water as steam until a pasty mass only remains. Dry this, and fuse it at a bright red heat in a fire-clay crucible. When the brown residue has cooled, digest it in nitric acid, and wash the brown powder on a filter with water. Dry this, and fuse to a button in a fire-clay crucible, using dried borax as a flux.—G. E. B.

Polishing.—W. D. H. (*Edinburgh*).—The cabinet to which you refer has probably been finished by what is known as ebonising, and your friend is, no doubt, quite correct in assuring you that it is not made of real ebony, which is very seldom used by cabinet-makers—so rarely indeed that it may practically be considered as non-existent. Any kind of wood can be ebonised, but those most commonly treated in this way are Honduras mahogany (baywood), American walnut, American whitewood, beech, and birch. None answers better than the first named. If the wood is sound, it does not matter if it is of bad colour or stainy. To ebonise, all you have to do is to stain the wood black, polish in the usual way, and then dull by dusting down with fine emery powder. The stain had better be bought ready-made. Darken the filling with black. A better colour can be got by using black polish than the ordinary kind. It is only necessary to put a little gas-black into the polish. Apply the emery powder with a brush or a soft cloth, and let the

motion be in one direction—with the grain—only. The powder soon removes the bright gloss from the surface of the polish. The bright parts are got by simply not rubbing them down. The composition for picture frames can be got from any gilder or picture-frame maker.—D. D.

Hodge's Mitre Shoot.—W. N. (*Winsford*).—Any large tool dealer—such as Melhuish, Fetter Lane, London; or Moseley, High Holborn, London—could supply you with one of these tools.

Tricycle House.—A. N. G. (*Bristol*).—A paper upon this subject appeared in WORK, No. 64.

Transferring or Copying Printed Matter.—G. M. (*Liverpool*).—There is a process which has been used for transferring the printed picture to white wood for ornamental purposes. The wood is varnished, and when so far dried as to be only very slightly sticky, the engraving is well pressed or rubbed upon it. The varnish is too dry to adhere tightly to the clean paper, but it adheres closely to the printing ink, which is, of course, of the nature of oil paint. The paper can be moistened and removed, but an impression of the engraving will remain on the varnished wood. However, if a part of the ink is taken away, the blackness and solidity of the original painting must suffer. Would not some photographic process be really better? When the printed matter is on one side of the paper only, I presume that a copy might be transmitted to sensitised paper without the aid of a camera; or, with a camera, producing a good copy under any circumstances would be easy.—S. W.

Couch Scroll.—KILDONA.—To make measurements of couch scroll clearer, perhaps the artist intends it to mean 2 ft. 8 in. from the floor to top of the scroll, which would be about right. The drawings are freehand. That from the top edge of box to top of scroll is about 20 in.; measured perpendicular, 16½ in. Nearly every couch made has a different pitch of scroll.

Picks.—JAMES.—I obtained my lock picks—which I find answer all ordinary purposes—from Messrs. Harding & Sons, Long Lane, London.—T. W.

Chime Clocks.—J. S. (*Edinburgh*).—The prices of chime clocks vary considerably, but the price of any ordinary chime bracket would be, in case complete, from £30 retail up to, say, £100, according to style of case, etc. I hardly know where the best place would be to get the movements only, but I should think Smith & Co., Clerkenwell; Thwaites and Reed, Clerkenwell; Evans, Birmingham; or Potts, Leeds, would supply them.—A. B. C.

Irregular Watch.—NOVOCASTREN.—I am doubtful if I can assist you much without seeing and examining your watch, but I am rather inclined to think that it may have become magnetised. Have you been in or near any place where a dynamo is, or anything else electrical? If not, have you at any time given the watch a blow or let it fall, and so cracked either jewel-hole or end-stone of the staff, or flattened the end of staff pivots? If neither of these has happened to it, then has the mainspring been broken or changed?—A. B. C.

Clock Tools.—A. B. X. (*Guildford*).—I do not think you can better either of these two—viz., Haswell & Sons, 49, Spencer Street, Clerkenwell; and Grimshaw & Co., 35, Goswell Road, Clerkenwell. From these I get nearly, if not quite, everything I require. For clock wheels, trains, and castings, I go to I. Mayes, 55, Red Lion Street, Clerkenwell. Also, I occasionally do a little (tools, materials, etc.) with Hunt & Son, 21, Ironmonger Street, St. Luke's.—A. B. C.

Bicycle Wheel.—SPRING.—Of course he must spring the fork wide enough to let one end free, when the other will pull out if the holes are not too tight-fitting on the shaft. The forks usually stand a considerable amount of spring outwards, and they have to be sprung in this way in order to get the wheel in.—A. S. P.

Phonograph.—F. W. B. (*Ardwick*).—The article on the Phonograph has not yet appeared. The promise given had nothing to do with Edison's latest instrument. Detailed instructions, with drawings, will be given, which will enable anyone possessing sufficient mechanical ability to make *a* phonograph. It would certainly be a "breach of patent," as you say, to make one of Edison's instruments for your own *use*. The cylinders are not on sale, neither are the instruments; they are let out at a very high rental.—W. D.

Chronometer—AUXILIARY asks me to give him a few hints regarding the construction of a chronometer detent for a bar movement. I do not clearly understand what is meant by "bar movement," but, in any case, I am afraid it is almost impossible on paper to say anything sufficiently lucid about the construction of a chronometer detent to be practically useful. A chronometer detent is the most delicate and exact piece of mechanism in the whole range of watch making, and it is difficult to learn how to make it even when side by side with a tutor. But to explain how to construct such a piece of work merely by describing the process in print is, I am afraid, almost out of the question. I take it for granted that AUXILIARY is acquainted with the shape and the purpose of a detent, and that he is anxious to make one himself. But I think he would be wise not to attempt to do so. It is the work of a chronometer maker, who is a specialist in this branch of the art, and it would be much more practical to send to a chronometer maker in case he requires a new detent applied to a watch. This, in fact, is what watchmakers of approved skill and experience usually do. It really requires a man who has all the appliances at hand and almost daily practice to construct a good detent. Of course, if AUXILIARY is a watchmaker, and in the course of his business has to handle job chronometers, he will frequently be face to face with little difficulties which, perhaps, he cannot overcome. If, therefore, he will specifically state any of these difficulties, I shall then be very pleased to supply him with any information concerning the case he presents for my consideration.—HERR SPRING.

Rusty Milk Pan.—A. D. (*New Cross*).—The defect in your pan of rust spots, causing holes in an almost new article, is unfortunately one that it is difficult, if not impossible, to account for; it is known in the trade as "pilling," or "rust spot." There was some considerable discussion on the subject in the *Ironmonger* some years ago, between makers and users of tin plates, as to the cause of this serious defect, but, as far as my memory serves me, there was nothing definite arrived at, except that the best brands of plates were as liable to it as the commoner ones. Milk is a non-corroding fluid, and as a rule, articles used in dairy work last a very long time, so that it cannot be from the action of the liquid. I should think myself that it is caused through there being rust spots on the iron before being tinned, and that a rusting action continues after the process of tinning, eating the iron away between the two coats of tin. I can detect a plate that will "pil"; the places are indicated by a few little marks like tiny pin-points. Select for your next bottom a perfectly smooth and brightly tinned plate, and have a good stout one; reject any that have little depressions in them, or the marks I have mentioned. Many ironmongers stock what are termed "perfect" or "prime" plates: these, being all selected singly, are certainly more likely to be free from defects than the others, which are termed "wasters," and with which the ordinary jobbing man repairs most articles brought to him. I do not see why you must have a new bottom every time you have a hole or two come; would not a tiny drop of solder over each hole meet your requirements, especially as your pan is only a counter-pan, and gets no special wear or knocking about? As a final suggestion, try a thin *tinned* copper bottom: this will last a very long time indeed.—R. A.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Preserving Ice.—J. R. (*Middlesbrough*) writes:—"How can I preserve about half a ton of ice gathered here from a pond? I want to keep it until July or August next. I have at my disposal a wine-cellar 20 by 12 ft."

Knitting.—H. B. S. (*Lockwood*) writes:—"Will anyone tell me if the fancy check stockings which are usually understood to be hand-knit can be made by machine, and if so, by what machine?"

Leclanché Battery.—C. F. W. N. (*Forest Gate*) writes:—"Will any reader kindly inform me where I may obtain a Leclanché battery or any other small battery to work an alarum bell, and what it will cost?"

Fan Covering.—PHONO writes:—"I am cutting a fretwork fan, and shall be glad to be informed as to where I can get it covered."

Regulator.—W. P. B. (*Colnbrook*) writes:—"Can any kind reader of WORK instruct me as to making regulator for egg incubator?"

IV.—QUESTION ANSWERED BY A CORRESPONDENT.

Newspaper Cart.—ESSEM writes, in reply to L. M. N. (*Liverpool*) (see page 765, Vol. II.):—"I send you herewith three rough designs for such a light conveyance as you ask for."

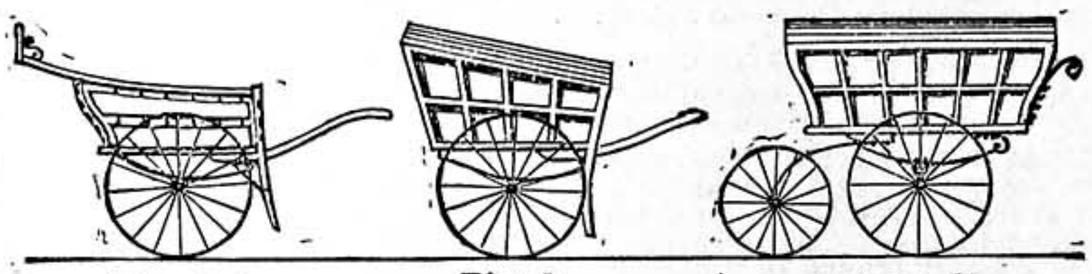


Fig. 1. Fig. 2. Fig. 3.

Newspaper Carts.

V.—BRIEF ACKNOWLEDGMENTS.

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